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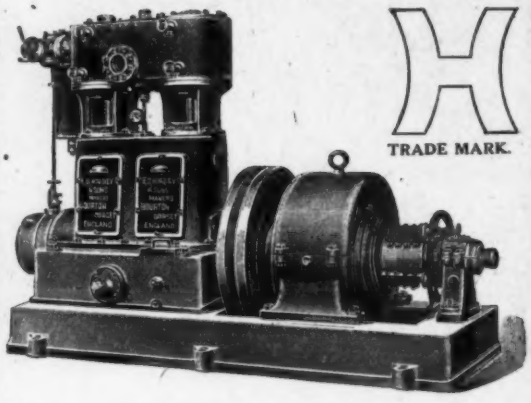

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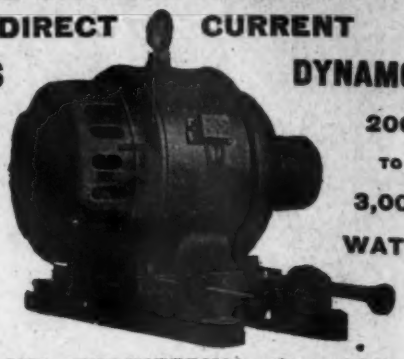

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ELECTRICAL REVIEW.

VOL. LXXXVII. SEPTEMBER 17, 1920. No. 2,234.

ELECTRICAL REVIEW.

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THE SITUATION IN JAPAN.

WHEN the World War began in 1914 Japan was "experiencing strong reaction" from the economic activity which followed the Russo-Japanese war. During the remainder of that year the downward tendency of business became accentuated, but early in 1915 there was a sudden and strong revival, and the large munitions orders from Europe and the disappearance of German and other European goods from markets in India, Java, China, and other countries in the Far East, created a strong demand for Japanese manufactures. This extended over several years, but with the signing of the Armistice in November, 1918, there began a period of deep depression and gloomy foreboding, for another twelve or eighteen months of hostilities had been expected. Orders were cancelled partly due to the falling off of war needs, but chiefly owing to the prospect of South Africa and Australia receiving renewed shipments of British and other European goods.

Electrical readers do not need to be reminded that Japan availed herself of the trading opportunities created by the war. Nobody will take exception to that enterprising action; it was the most reasonable thing for a rising manufacturing people to do, and temporarily it was very useful to the rest of the world.

Some Japanese manufacturers and merchants, however, in their anxiety to make hay while the sun shone and to accumulate big profits rapidly, placed goods of very inferior quality on denuded markets. We heard a good deal of this in the electrical field for some time. This imprudent policy (says Mr. Hugh Horne, Commercial Secretary to H.M. Embassy in Tokyo, in his report on the Commercial, Industrial and Financial Situation of Japan in 1914-1919)* was largely responsible for the numerous post-armistice cancellations, and has aggravated the difficulty of consolidating positions in such countries as India and Java. In other words, a reputation for inferior quality is not easily lived down.

Prior to the war it used to be considered that the cost of labour in Japan was very low indeed, placing her industries, as they might develop, in an exceptionally favourable position in respect of export prices. But the war, which brought great prosperity, altered the attitude of the workers, who were not slow to realise that they had not received a fair share of the results of their labour. "They are beginning to feel their strength." Before the war there was, "properly speaking, no labour problem in Japan," but the workers have organised their forces, claiming advancing wages, shorter hours, improved conditions, a share in the profits, and a voice in control. We judge that they have not made much progress in certain of these directions. While the Government punishes strikes, &c., with imprisonment, it intends to allow Trade Unionism and combined action in general to develop on natural lines; but Japanese Trade Unionism differs from that of the West, as it is limited to "Unions operating in individual factories, and not for any industry or employment as a whole."

Under the new legislation of the last few years a working day of 12 hours is provided for, but factories employing only male operatives over 15 years of age may exceed this limit. The present average wages are stated to be over 100 per cent. in advance of pre-war rates, but in certain cases the rise is considerably larger. The conductors and drivers on the electric tram cars in Tokyo, for example, now receive Yen

* H.M. Stationery Office, 9d. net. (cmd. 912).

60 per month, as against a pre-war wage of Yen 20. Though a 70 hours' week is common in Japan, there is a general eight hours day agitation. Mr. Horne says that the principle has been fairly generally accepted in theory, but the eight hours really constitutes a basis for the settlement of wages for overtime working conditions, and the Japanese labourer, speaking broadly, prefers to work long and leisurely, and requires little time for rest, food and recreation. Employers find that the eight hours system is acceptable, because they can reduce their wages bill when work is slack, and the employés favour it because they can claim the same wages for an eight hour day as they formerly received for 10 or 12 hours. The increase in efficiency required to off-set a shorter working day, when the eight hours day is accepted in practice, is one of the chief problems of Capital.

The handling of machinery in Japan is stated to leave much to be desired, and labour-saving devices are at present comparatively little used. Taking all the circumstances into account, it is open to doubt whether the actual cost of production of competitive goods is to-day lower in Japan than in England. In any case, says Mr. Horne, "the difference in favour of Japan is not enough to justify the alarmist views which find wide expression in Great Britain and her Colonies."

Fear of a future shortage of coal for industrial purposes led to a great deal of attention being directed to hydro-electric enterprises during last year. Numerous companies have been formed for the utilisation of water rights. Between 1908 and 1918 the number of companies interested in hydro-electric development increased from 262 to 852, and the H.P. developed advanced from 110,000 to 1,002,000, but at the end of 1918 schemes for a further 2,000,000 H.P. were in process of actual development, while it was also calculated that 5,000,000 additional H.P. could be developed economically in areas not then leased for hydro-electric operations. A survey scheme has been instituted by the Japanese Government under which an examination of the country's resources for the five years 1918-1922 is being made.

During the war, copper, antimony, tungsten, and graphite were among the goods shipped in large quantities to the Allies, and there were big increases in porcelain, glassware, enamelware, electrical goods, and other lines. We note that Mr. Horne does not include electrical goods among those most likely to retain their wartime position. Last year the total exports of all goods increased slightly in value, but quantity decreased owing to economic causes, one of which was the renewal of European competition. There was a large increase in exports to China.

In general export trade, metals and metal manufactures show a strong tendency to fall away. The exports of insulated electric wire should be quoted as showing the great advance made in two years and almost maintained up to the end of last year:—

	Quantity. Kin.	Value. Yen.
1916...	1,552,868	1,125,632
1917...	3,451,158	3,118,915
1918...	9,556,794	8,324,333
1919...	9,375,767	8,411,700

Electrical machinery and textile machinery are going out of Japan in increasing quantities; the electrical goes chiefly to China and the Kwantung Province (through Dairen), which between them took over 60 per cent. of the shipments.

So far as import trade is concerned, British machinery is as much in demand as ever in Japan, but so long as there is difficulty in our giving satisfactory delivery, and high prices continue, the buyer is being driven into the American market. The needs of Japan are being closely attended to by American manufacturers, who are determined to spare no effort to retain their hold. The heaviest items in the list of imported machinery during the last three years include steam boilers, dynamos, electric motors, transformers, gas compressors, pneumatic tools, metal and wood working machinery, &c.

"Given a model on which to work," says Mr. Horne, Japanese local production, especially of electrical machinery, is now of satisfactory quality, and several concerns have made agreements with British and American concerns whereby the latter allow their patents to be worked in Japan against payment of royalty. The American General Electric Co. has considerable interests in two large concerns in which its models are produced for the local market. Japanese engineers have been securing training and instruction in America, the trade-getting value of which to the States is obvious. "Japanese electrical practice," we read, "has always followed America and Germany, and mining engineering America." Where do *we* come in? That question will no doubt receive attention from British manufacturers as they read this British report.

So far as methods of trading are concerned, our firms are advised that, in the absence of direct representation, where big or complicated business is handled, by far the most satisfactory course is to function through the medium of the established British firms in Japan, because their experience of local conditions enables them to avoid many difficulties which might otherwise occur. Co-operative selling is recommended, but Commercial Secretary Horne reiterates his warning of the danger that high prices and delayed deliveries handicap us in re-establishing markets for British goods. He points emphatically to the growing danger that some fields in which we were formerly paramount may pass into American and other hands. There is a general impression that full efforts are not being made to retain and maintain the pre-war position. "The British reputation for quality and square deals is as high as ever, but cost and delivery are naturally very strong factors of decision when important contracts have to be placed."

The report before us does not contain mention of the branch activities of British electrical manufacturing interests which we understood to be on foot. Possibly more may be said regarding these when Mr. Horne again deals with the situation. It is very important that we should be alert, for considerable railway electrification schemes are in contemplation as part of the Imperial Government railway system, including the Kobe-Osaka-Kyoto section and the Yokohama-Kozu section; large business interests have organised a scheme for a high-speed electric railway between Tokyo and Osaka; and a further private enterprise is for the construction of underground railways in Tokyo.

Such reports as that to which we have made reference in the foregoing give rise to greater impatience than ever with the shortsightedness and folly which characterise our home industrial situation. It is deplorable that when there is such urgency for our getting into our stride in foreign markets, so full of opportunity for enterprise, we should be consumed with our own industrial differences. What a boon to British industry it would be, and what a guarantee of future full employment for hundreds of thousands of British workers, if we could induce a ship-load of agitators to study the needs of the world, and to understand the urgency for strong and united British action in whole-hearted production. We need to lift our eyes beyond the immediate details of life at home for a time, and look afield—beyond Russia. Reasonable rest in place of incessant industrial unrest, would promote such stability that future security and prosperity would be assured.

Is it too much to urge the Government and manufacturing interests, too, to do something to bring home to the understanding of the millions of workers of Britain the advice of the expert trade observers which is contained in the recently-issued reports to the Department of Overseas Trade? Through the trade Press we are enabled to carry their facts and conclusions to individual trades, but even a wider and fuller propaganda should be made. It is true that these reports are prepared chiefly for the manufacturer and the trader with whom lies the exercise of commercial initiative, but they vitally concern the bread-getting of the worker, his wife and children, and his children's children, and he ought to know what they contain.

Distribution Pressures and Wiring Rules.

The article contributed to this issue by Mr. C. H. Wordingham (Chairman of the I.E.E. Wiring Rules Committee) deals with a subject which at this time is of exceptional importance not only to electricity supply authorities, but also to manufacturers and contractors. We appear to be approaching an epoch in the history of the utilisation of electrical energy—an epoch that was clearly indicated in Mr. Gillin's masterly paper before the I.M.E.A., and has been foreseen for some years by engineers who have investigated the conditions which will probably obtain in electricity supply at no distant date. The public is learning to appreciate the unique advantages of employing electricity for every possible purpose in the home, the office, the shop and the factory, and is developing a constantly-increasing appetite for electrical energy. How shall that appetite be satisfied?

If, and when, the use of electricity is fully developed, the demand will be so immense that the employment of distributing mains on the lines of present practice will become commercially impracticable. Electricity will have to be distributed at pressures much higher than the present limit of 250 volts, and the question arises: What system shall take the place of that which has become standard practice in all large towns?

Various alternatives have been put forward, such as the multiplication of transformers in street-boxes at almost every street corner, the short low-pressure distributing mains being fed at the present voltages and the transformers from high-pressure distributing mains; or the substitution of a complete high-pressure distributing network, with transformers on consumers' premises; or the adoption of a higher pressure for distribution directly to consumers' installations. Only in the last-named case can the continued use of direct current be considered, and even in that case it offers no appreciable advantage over alternating current, while its drawbacks are patent. We may take it, therefore, that the use of alternating current will ultimately become universal.

With regard to the raising of the supply pressure, the arguments against this proposal appear to us to be overwhelming. Even at 220 volts, the lamps available, or likely to be available, are neither so efficient nor so robust as those made for lower voltages, and the range of candle-powers for which they can be made is limited, especially in the case of the gas-filled type. The stress on the insulation of the wiring and fittings is quite high enough at 220 volts, and the construction of switches and fuses for that voltage is materially more costly and difficult than for 110 or 50 volts. Moreover, the risk of accident would be very seriously aggravated by any increase in the voltage of supply. We do not agree that there is any appreciable risk to the person at the voltages customarily employed in domestic applications; it is true that fatal accidents have occurred with both A.C. and D.C. at 200-250 volts in houses, but they have been almost wholly confined to the bath-room, to the special conditions in which we have repeatedly drawn attention, and we cannot call to mind, during the whole period of use of pressures above 100 volts, more than one, or at the most two, cases of fatal shock in living rooms. The risk to life in houses at present voltages is, in our opinion, so remote as to be absolutely negligible; but if the voltage were increased, this immunity from accident would quickly disappear.

The second alternative, which is advocated by Mr. Wordingham, does not commend itself to us so much as the first. The experience gained with the house transformers so generally adopted in the early days is, it is true, of little weight, in view of the vast improvements in technique that have been made, but the initial cost would be enormous, the waste of energy in myriads of small transformers deplorable, and the risk of accident due to carrying 3,000 or 5,000 volts into a private house, despite all precautions, a grave objection. We prefer the multiplication of street transformers, which would involve the minimum disturbance of distributors, would retain the transformers under the control of the supply authority, and, owing to the shortness of the distributors, would minimise the need for increasing their cross-sections.

As for the interior wiring of buildings, we have long felt that, with due respect to the admirable Rules of the Institution of Electrical Engineers, the matter has been overdone. The Rules were introduced at a time when the multiplicity (and, we regret to add, in many cases the fatuity) of different codes rendered the promulgation of a single standard set of Rules acceptable to all parties a real blessing. Thanks to those Rules, the incoherent mass of contradictory and pettifogging regulations has been swept away. But the Augean task has only been accomplished, apparently, by constantly raising the standard—to a final pitch approaching absurdity. No experienced engineer can deny that thousands of installations which defy the Rules in almost every particular have given satisfaction over long periods of years, and are giving satisfaction to this day. It is a plain fact that our standard of wiring is far in excess of reasonable requirements; there are exceptional cases, we grant, but let them be treated as such—and let the ordinary household be wired more in accordance with common sense and less in accordance with idealistic standards.

The Electrical Lock-out and Strike.

Thanks to the action of the Electrical Trades Union, the area of the dispute which led to a lock-out of electricians by the Employers' Federations has been widened; the E.T.U. has given notice to withdraw its members from work in electricity supply stations, in the hope of shutting down electric light and power, traction, &c., throughout the whole country.

This means that in order to bring pressure to bear upon the Employers' Federations, the Electrical Trades Union has declared war on the general public, who will be the real sufferers if its purpose is effected.

Next we have the Electrical Power Engineers' Association offering to take a hand in the game—a move which we regard with amazement and regret. Bound by an alleged agreement with the E.T.U., the E.P.E.A. declares that it must take sides against the employers, *regardless of the merits of the question in dispute*. That a body of technical staff employés, trained to use their brains, and hitherto regarded as good citizens, should commit itself to such a compact is incredible; we simply refuse to believe it.

But the *leaders* of the E.P.E.A., nevertheless, appear to have innocently blundered into a trap of this sort, and thus a very serious situation has arisen—fraught with grave consequences either to the public welfare or to the Executive Council of the E.P.E.A. We do not suggest that the Executive harbours any intention of sharing in the political manœuvres to which the E.T.U. Executive is addicted, any more than the members of the Association; but the fact is that the E.T.U. has been too astute for the E.P.E.A., and has put the latter in its pocket like a tame monkey, with the result that the Association is being jockeyed into a "direct-action" strike. Do the members realise what they are in for?

Let us see what the quarrel is about. It is constantly alleged by the lay Press, with most mischievous effect, that the dispute is about the appointment of a foreman at Penistone. It is nothing of the sort. The question at issue is an old one, which was fought out in 1897, but has been resurrected by the E.T.U.—namely, shall engineering employers retain the right to manage their business, or shall they hand over control to the employés? That is the question in a nutshell; and should the E.T.U. win, the E.P.E.A. would be its humble servants.

To-morrow the power-station members of the E.T.U. are expected to stop work. The E.P.E.A Executive has not called upon its members to follow suit, but it threatens to do so. We confidently appeal to the members of the Association to remember that their duty to the State takes priority of their duty to their Executive, and to remain at their posts.

The question at issue is one which cannot be submitted to arbitration; it lies at the root of industrial organisation. The E.T.U. is out for "the control of industry." The secretary, Mr. Rowan, has referred to the employers as "the enemy," who are to be "swamped." We quote from the *Electrical Trades Journal*, the organ of the E.T.U. If the employers are swamped, the staff will have a poor time; let them consider the situation and step warily.

ELECTRIC WELDING.

By "ELECTRODE."

Electric welding has come to the fore-front rapidly, and is to-day in general use for all branches of engineering, as by its aid, defective castings or faulty machinings can be rectified in the early stages of manufacture, thus preventing the "scrapping" process, which was some few years ago, the natural sequence of error or accident. To-day, however, it is possible by judicious "welding up" of worn members to postpone the day of obsolescence, and it is in this connection that there is a tendency to be too optimistic regarding the prolongation of life which such a fitting may have after repair.

It is a sound principle to thoroughly examine each defective detail, and also to look into the history of its

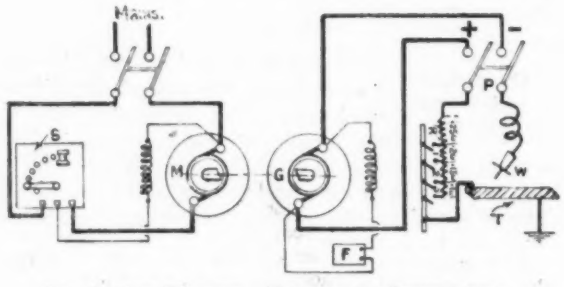


Fig. 1.—Arc Welding. Diagram of Connections.

service, bearing in mind the fact that years of duty often cause the metal structure to become crystalline in nature, especially if the metal has been exposed to the weather and undue strain.

Much has been written and many are the papers that have been read regarding the process of electric welding, but in the main these have not been written for the practical man. It has been found as a result of long experience that the success of an electric welding operation lies very largely in the hands of the operator himself, the personal equation, which we so frequently omit from our calculations and discussions.

In the early days of reconstruction, when shipbuilders were receiving more orders than they could undertake, it was found that we still had a great deal to learn about electric welding and its applications. Early experimenters insisted that a minimum voltage of 100 was essential with a corresponding current value of 100 to 200 amperes. To-day the voltage figure, by common consent, has been reduced to 60, and in some cases to 25, with corresponding varying current values.

Shipbuilders were quick to note the advantages to be gained by welding and to appreciate the impetus which production would receive once a thoroughly reliable and approved method of electric welding was adopted, and many enterprising firms had to ascertain by trial which type of electrode and what voltage limits were required for all classes of work. To do this they had to rely very largely upon the results obtained by the welding operator, who, in turn, had to find by means of trial and error which particular set of values and type of electrode furnished a weld of "good hard metal." This can best be tested by chipping the newly deposited metal with a hammer and chisel, which will at once reveal the texture of the weld and also prove its amalgamation with the metal member.

Carbon Electrodes.—For some years practically all the defective castings in foundries have been rectified by welding, using carbon electrodes and building up the "blow holes" by fusion. This operation requires a heavy current, generally 300 amperes, depending upon the size of the depression to be levelled while the arc voltage necessary is approximately from 45 to 50. It is interesting to note that for this work the job to be renovated is laid on a steel table which is generally connected to the positive pole of the circuit; this always gives better results than can be obtained by a reversal of polarity. The carbon electrodes for average foundry practice are $\frac{3}{4}$ in. in diameter, and 14 in. long, and the rate of consumption with 300 amperes is about 2 in. per hour.

Metallic Electrodes.—These have come into marked prominence more recently for all classes of welding repairs, especially for fine metal seams. The voltage required by the arc is 25 to 35 for fine electrodes (uncoated) ranging to 60 for the larger-diameter electrodes which are coated with a heat insulating covering consisting chiefly of asbestos, which thus prevents radiation from the electrode and maintains the temperature gradient. The size of electrode to be used must be determined by the size of repair to be effected; this applies to all welding operations.

As a useful guide for general practice, it should be noted that coated electrodes require a higher arc voltage proportional to the thickness of the covering while at the same time a reduction in the current density should be made in order that the correct welding heat may be maintained. In tramway and railway track repairs, special electrodes of 12 per cent. manganese steel are usually employed for levelling up the rail corrugations or curves, and to fill up the worn edges of points and cross-overs. These latter being of manganese steel, it is imperative that the metal to be deposited should closely approximate to that of the rail under repair, hence the adoption of the manganese steel electrode. For such operations as this 60/80 volts with a current of 150/300 amperes has been found quite satisfactory. Immediately upon completion of the weld, the welded area should be "swabbed" with water to chill it, thus ensuring a hard impervious metal skin.

Slag-covered electrodes are used largely where it is essential that the welded area should be perfectly free from any blow holes, and where maximum penetration of the

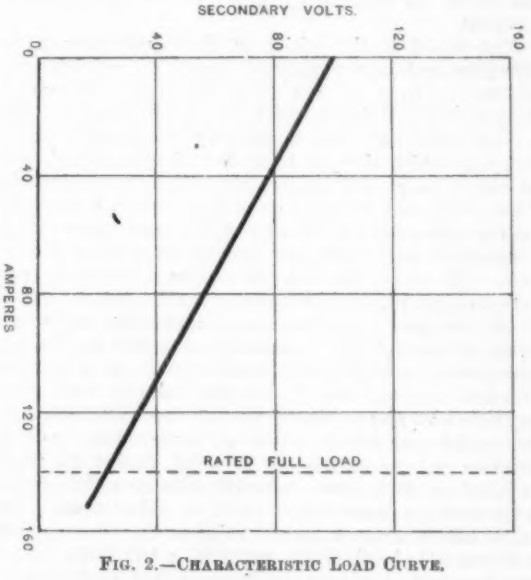


Fig. 2.—Characteristic Load Curve.

metal is required. Owing to the slag covering, a comparatively high voltage is required, say, from 80 to 90. The slag floats on the top, thus sealing the weld as it progresses, and when finished and cool the slag can be easily chipped off, leaving a clean surface.

Mild steel rods of 8 S.W.G. are becoming increasingly popular for steel plate and bulkhead work in ship repairs. When these are coated with a flux which sometimes consists of graphite and china clay, the metal runs quite freely. For this size of electrode a current value of 120 amperes, with an arc voltage of 30, is now customary for average welding work.

For each size of electrode there is a certain current value, and this should be determined and adhered to, as excessive current only results in the welding metal being blown away

from the end of the rod instead of being quietly and smoothly deposited on the work in hand.

Welding Plant Equipment.—The plant required for arc welding is of a simple design, and requires very little skilled attention during operation and maintenance. It consists of a motor-generator set, the motor being wound for the requisite supply voltage, and the generator capable of giving a voltage range between, say, 30 and 100. The generator should, preferably, be of the reverse compound-wound type; that is, with the series turns arranged to oppose the shunt excitation, thus allowing the voltage to drop at the "arc," reducing the heavy current peak when striking the arc. This equipment, when of a portable nature, becomes very useful, and can be transferred to any part of the factory, and brought near to the work to be welded, minimising the voltage drop in the electrode leads.

This "drop" should not exceed five volts when fine electrodes and low arc voltages are being used. It is necessary to include in series with the arc, a steadying or ballast resistance to prevent a "dead short" across the generator armature when the arc is struck. This resistance should be of ample capacity, and should, preferably, consist of grids admitting of free ventilation. If the generator equipment is fitted in a permanent situation the steadying resistance can be sub-divided and connected to S.P. switches to permit of current adjustment, as shown in fig. 1. When the welding set is portable this resistance adjustment can best be effected by fitting to the cable a clamp or clip, which can be withdrawn, or re-inserted, in any grid at will. The set requires no special design, but the generator should be capable of withstanding the racking loads, as these may vary from zero to 50 per cent. overload in a few seconds as the arc is struck. Where the welding has to be carried out remote from the welding plant, it is better to arrange for the generator field to be cumulatively wound, so that on load the series windings assist the shunt excitation and maintain the voltage at the arc.

The size of the welding equipment must be decided upon according to local conditions, but in practice it has been found, as the result of prolonged observations, that 5-KW. per welder is sufficient for average conditions. At one time it was considered to be more efficient to lay down a large welding plant sufficient to keep 30 or more welders working, but in practice it has been found that much better results and a steadier welding voltage can be obtained by installing a motor-generator set sufficient for two or three welders. This keeps the plant within the limits of portability.

A.C. versus D.C.—Electric welding by means of alternating current possesses several advantages over the use of direct current, the chief claim put forward being that deeper penetration is possible by using A.C., and also that when reactance coils are installed a "dead short" across the welding electrodes produces no serious effect. Perhaps its greatest use and advantage is seen in the application of alternating current for the cutting of metals, and to-day it is possible to cut mild steel plates ½ in. in thickness with a current of 250/300 amperes quite easily, and in a very clean manner. For overhead work on ships' beams and bulkheads, A.C. has given satisfactory results.

On the other hand, it is contended (and, in the writer's opinion, justly so) that "safety first" should be the primary consideration, and that A.C. is more dangerous to use. It is quoted, as an instance, that a shock of 50 volts A.C., if received under damp conditions by a welder, would be sufficient to disturb his balance, and if he was employed on staging work such a shock might be accompanied by serious results.

At one time it was found that cast-iron could only be satisfactorily welded by means of an alternating current, and this was a strong point in its favour, in view of the large number of castings which fracture in service. Satisfactory cast-iron welds are now possible by experienced welders on the D.C. system, and the point is evidently one which has been solved by experience.

Fig. 2 gives results of the characteristic regulation of a small transformer designed for welding with its primary arranged for 400 volts. This transformer was specially designed to withstand complete short-circuit on the secondary side.

DISTRIBUTION PRESSURES FOR DOMESTIC SUPPLY AND THE CHEAPENING OF HOUSE WIRING.

By C. H. WORDINGHAM, M.Inst.C.E.

In the course of a discussion on mains at the recent I.M.E.A. Convention the writer ventured to refer to the pressure at which the supply to domestic consumers should be given. Since the time then at his disposal was altogether insufficient to enable him even to outline what was in his mind, it may be well to call attention in these columns to some of the considerations affecting this question.

However desirable a "cheap and abundant supply" of electrical energy may be, and however successful H.M. Commissioners may be in securing such a supply to authorised distributors in the form of untransformed high-pressure energy, it will not help the domestic consumer much if the distribution costs which have necessarily to be added in his case be heavy, and the cost of the installation in his house be prohibitive or the restrictions on his use of the supply vexatious.

Let us recognise the situation clearly: Either we do or do not believe that electrical appliances have such merit that they are desired by the man in the street, and that it is for the general well-being that they should be brought within his reach. In other words, is there a real practical need for electric cooking ranges, washing machines, vacuum cleaners, flat irons, curling tongs, hair driers, toasters, radiators, and small motors in the British home? If so, can they be bought at a price and run for a charge which the consumer can afford to pay; also can they be so made that they will bear the wear and tear of use by unskilled hands?

Most electrical engineers believe that the answer is "Yes," but many realise also the difficulties in the way of so supplying these appliances that the conditions as to cost and reliability can be met. How many central-station engineers to-day could honestly say that if all their consumers to-morrow applied for a 3 or 4-kilowatt cooking range they would welcome the applications? Could they supply them from their existing distributors? Would it pay them to lay the additional distributors necessary with the pressure now in use? The fact is that up to now distribution networks in domestic areas have been planned for lighting and nothing else. If a supply for all the purposes to which, when cheap and abundant, electricity can be applied in detail is to be given, mains capable of carrying much more power are imperative. With pressures even of 240 volts the cost is so heavy as to run up the price to the consumer considerably. It was the suggestion made in the Convention paper to increase these pressures that drew forth the writer's protest.

It is idle to deny, in view of experience, that, while for all normal individuals 220 volts direct current is perfectly safe, alternating current of the same pressure can cause, and in a number of cases has caused, death. Would any central-station engineer commit himself in cold blood to the view that, knowing this risk to be present, he should hide its existence from the public? What would he think of a water engineer who knew that he had a stream containing typhoid germs that was likely to contaminate his reservoirs and deceived his consumers into thinking that they need not boil the water they drank? For observe, in neither case is there any inherent need for the risk, which may be completely eliminated by the use of direct current or a lower pressure for alternating current in the one case, or by diverting the contaminated stream in the other. What would be the feelings of an engineer who deliberately introduced this dangerous pressure into a nursery, and had a dead child brought to him as the victim of his wilful misrepresentation? It is no answer to say that there must be fatal accidents in connection with all modern developments, that some people must be killed by motors or railway trains, and that electricity is no worse than its neighbours, gas,

for example. The reasoning is false; unavoidable risks can be excused in this way; easily avoidable ones cannot. As a matter of policy, too, is it wise to say: "I am no worse than my neighbours," when it is easily possible to say: "I stand alone on a plane above all competitors; if you do your work electrically you run no risk, if you use gas, coal, or oil, you will probably come to an untimely end or burn down your house"?

This question of shock has become of vastly increased importance of late because the opinion is now firmly held that, whatever the inherent advantages of direct current may be, and they are undeniably great, that form of current must go for general supply, because cheap generation involves transmission over long distances, and the use of alternating current; we cannot afford to be saddled with the cost of providing and operating conversion plant. This means that the greatly extended use of electricity to which all are looking forward will be realised entirely by alternating current; hence the importance of keeping the pressure down to a safe limit.

Frankly, for economy, substantially higher pressures must be employed than 240 volts if a large density of demand is to be met. This has already been recognised with regard to motive power, it being common practice to supply large consumers at a pressure of 6,600 volts or even higher. Probably in future large schemes the transmission pressure will be transformed to 10,000 or 11,000 volts for primary distribution, and this pressure will be the ordinary one for supply to large power users. For distribution for domestic purposes 2,000 or 3,000 volts would seem the most suitable. These are easily manageable pressures, and either would lend itself to efficient distribution. This leads us back to "house-to-house" distribution, which many had thought gone for ever, but with the large house loads to be anticipated it will probably be found to be justified in a slightly modified form. No doubt only very large premises would have their own transformers; the usual practice would be to group several houses together and in some cases a whole street. With such a scheme it would be easy to use a pressure of only 100 volts or even 50 volts on a consumer's own wiring. In this way all danger of shock would be eliminated, and it would be possible greatly to simplify and cheapen the wiring.

The cost of wiring has always been a thorn in the side of the central-station engineer—now it has become a veritable bayonet. The serious handicap under which electrical appliances labour from this cause has long been recognised, and numerous have been the attempts to mitigate it; hire-purchase arrangements—sometimes without the purchase, and then misnamed "free"—special kinds of cable, special systems of wiring, and so on, but the difficulty still presents itself, and is now aggravated by the high cost of material and labour. It is to be feared that existing standard Rules cannot be held blameless in the matter; they have been framed mainly with the laudable object in view of securing the very highest class of work and the complete elimination of the remotest fire risk and of the risk of shock such as is present with the higher low pressures. There has been subconsciously present in the minds of the framers (and let it be said frankly that the writer has been one of these continuously since the early 'nineties of last century) the case of the country mansion, large palatial offices, and fine public buildings. So long as public supply was partial and electrical appliances chiefly for the rich or well-to-do there was ample excuse, if not reason, for this attitude of mind, but for a good many years past these conditions have been changed. In consequence the inapplicability of the one high standard to all cases has forced itself upon those concerned, and the result has been the more frequent breach than observance of the rules in a multiplicity of instances. To frame one set of regulations to meet the requirements of all classes of installations from the palace to the fried-fish shop is to essay an impossible task; yet this is what the present Rules do. This must be recognised, as also must the fact that our present outlook is utterly different from what it has been in the past. We are now on the eve of tremendous developments when we may hope that every house other than a hovel will have electrical energy in use in it in one form or another, and we must rise to the occasion and broaden our outlook.

Future Rules should recognise more than one grade of wiring, rising from that which is just safe and the plainest of the plain, to that which is the best and most elaborate that money can buy. More important still—and this is the chief point of contact of this matter with the main subject of this article—they must discriminate between installations intended for different pressures. It may be contended that at present there is no material difference in the cost of wiring at 220 volts and 50 volts, but the reason for this is the uniform set of Rules; no one can deny that the risks of failure of insulation are greatly reduced with the lower pressure, and that, in consequence, the Rules can safely be much relaxed where it is in use.

With 50-volt alternating current a very poor dielectric on the fixed wiring will suffice; trailing conductors of flimsy character for portable appliances will give satisfactory service; nothing need be earthed, as no shock is to be apprehended; switches and fuses can be of the simplest character since arcing is lifeless, and all parts can be safely handled alive; incidentally, incandescent lamps are more robust, efficient, and longer-lived. The elements in all heating and cooking appliances are very much more substantial, and their insulation can be secured with much less care.

Objection may be raised that the heavier conductors for the lower pressure will more than wipe out these gains, but this is not the fact. In the first place, most of the small wires in use on 220-volt installations are for the reason of mechanical strength much larger than they need be for the currents they have to carry, and they would do equally well for 50-volt work. It may be said that that is all very well for lighting, but suppose you have to supply radiators? Will not the cables be massive and costly? To this the writer would venture to reply by pointing out that when you put on a radiator you usually want warmth, and that it is not essential that the whole of the heat should be generated at one spot. Why should not the conductors to the radiator be insulated with a fire-resisting covering, and be run at a temperature as high as that of hot-water pipes? They might even be run hotter still without making the air feel unpleasant; there could be no valid objection to this course if their high temperature were kept in view when the wires were run and precautions similar to, but not more stringent than, those usually observed for hot-water pipes were taken; distributing a portion of the heat would be advantageous rather than otherwise. In a small house the runs would be short, and the greater part of the wiring would be situated where the heat would be of use.

Ease of connection is almost as important as low cost of wiring and appliances; the popularity of the "adapter" shows how great a value the public attaches to this feature. Now an adapter is about as unsatisfactory a fitting as can well be found; it is usually of wood, the contacts, instead of being oval like those of a lamp cap, are round, and can hardly be induced to touch ever so slightly the lamp-holder plungers; the cord comes out centrally, and is grasped within the hand so that if it is worn and an arc occurs the householder gets the full benefit of the heat and shock. Ordinary wiring according to the Rules is much too unadaptable, and by providing only lampholders as outlets, practically forces the consumer to use the objectionable fitting mentioned, and the slender wiring for a single lamp. Of course, sockets can be provided and ordinary plugs, but these add to the cost of the installation, and are usually fitted in the wrong place. The practical conditions of the ordinary house would be much better met than at present if the fixed wire were taken to a single convenient point and terminated there in a simple fitting with a

number of ways. Each way would comprise a simple and efficient contact to which a flexible wire, also terminated in a suitable contact, could be attached. By this means small appliances could be easily connected by the consumer himself, and lamps could be fixed where wanted or their positions altered at will.

A great step forward in popularising electrical appliances would be made if every portable fitting were wired to a standard socket on the fitting, instead of taking the flexible wire directly on to the lampholder. The fitting could then be permanently wired, and the flexible conductor would not fray where it enters. Flexible conductors terminating at one end in a plug to suit the portable fitting, and at the other in a plug to suit the contacts on the multiple-way fitting above suggested, should be kept in stock in a number of standard lengths. Were this done an ordinary householder could renew his worn-out flexible conductor as easily as he now renews his worn-out flexible gas pipe. Until electrical appliances are reduced to the same level of simplicity as those for gas it is hopeless to expect their general use among the masses.

At the risk of wearisomeness, it must be emphasised that what we have to cater for is the ordinary home of the great mass of the wage-earning population and the lower middle classes; the people who either have all the house work to do themselves, or who, while provided with one or more domestic destructionists, called in polite society "maids," find the use of their own hands in many instances conducive to the preservation of their property and digestive organs. The kind of house to keep steadily before one's mental vision is the one with eight rooms, though there may be a small percentage of houses rising to 20 rooms, and falling to three or four rooms. The people who live in these houses should be able to go to the nearest ironmonger or general store and buy their kettle or their curling tongs over the counter, and be able to connect it to their installation when they get home, without having to call in a superior person in the form of a wireman and his mate, who talk loftily about "insulation," which the consumer does not understand, and about "earth," which he misunderstands. If this state of affairs is to exist it can only be achieved by ensuring that more or less shoddily-made appliances can be used with immunity from serious risks.

All the foregoing observations apply to the class of installation indicated. For large houses, high-class shops, offices, and important buildings generally, the course proposed is obviously unsuitable. For these large blocks of demand, by all means use the highest pressure practicable with corresponding precautions. Lighting and small appliances will be best supplied at 240 volts, but large appliances such as cooking ranges, even at this pressure, are a terrible nuisance to the supply authorities, and costly in mains. It would seem well worth while for appliances of this kind to have self-contained transformers which would take a distribution pressure of 2,500 volts and transform down to, say, 10 volts on the heating elements, which would then be so massive that their durability would be great, while all risk of shock to the user would be completely eliminated. There is no reason why 2,000 or 3,000 volts should not be perfectly safely carried on cables in hotels and similar buildings.

Even in installations of this character, however, it is worthy of consideration whether we are really on the right lines in respect of our present practice for high-class work. The primary advantage of electrical distribution, indeed the main feature which justifies its existence, is its convenience and adaptability. The ease with which a cable can be carried round obstacles, and then taken through inaccessible spaces, as compared with the rigid pipe necessitated by gas, steam, or hydraulic power is surely too valuable an advantage deliberately to throw away. Yet this is what is done in all systems of conduit protection, and in the forbidding of the use of flexible conductors. It surely cannot be right to expend the major portion of the labour necessary for putting up an electrical installation on the erection of a rigid system of piping into which the unhappy cable is later on drawn (though often the piping is threaded on it as the work proceeds), when it might so easily be laid neatly and inconspicuously by itself, and the whole of the labour of pipe fitting saved. In elevating this conduit system to its present pinnacle, engineers appear to have been obsessed by the vision of numerous individuals wandering about buildings with hammers and nails, which latter they drive into walls, floors, and ceilings indiscriminately for no apparent object, while every house is assumed to be infested with rats and mice. How often are nails actually driven into the walls of a high-class building or into the floors? Is all this elaborate mechanical protection that is pressed for really necessary? In any case it should surely not pass the wit of man to invent some less cumbrous scheme than piping. Why, too, it may be asked, should wiring be concealed? Could not some way of making it even attractive be devised which would save the wasteful expense that is now practically forced upon the user?

It may be interesting to recall the early days, when Deptford was first conceived in the mind of Ferranti. It is no less than marvellous to look back and see the extraordinary manner in which his intuition, for such it really was, led him to formulate his scheme on lines which later theory and practice have shown to be correct, and in consonance with which the most modern plans are being laid. He had high-pressure transmission, alternating current, easy and efficient transformation of pressure, a fairly high intermediate distribution (2,400 volts), a very low pressure on the actual house wiring (100 volts and 50 volts). The proposals in this article are no more and no less than the advocacy of a return to Ferranti's initial proposals. The extensive distribution of alternating current at low pressures of the order of 220-240 volts was really a departure from his original scheme, which was probably brought about by the prevalence of similar distribution of direct current with which it was practically inevitable. In the writer's judgment, we shall see a return to the high distribution pressure accompanying the practical elimination from new schemes of direct-current distribution, and this high pressure will once more be transformed to the very low pressure that is suitable for the house.

An 8,800-ton Electrically-welded Motor Ship.—It is stated that the Merchant Shipbuilding Corporation (an American shipbuilding firm) is to build a vessel of 8,800 tons deadweight of the Standard Emergency Fleet type, 401 ft. in length, the hull of which is to be electrically welded throughout. It is claimed that this vessel will contain 15 per cent. less steel than a riveted ship, and that 40 per cent. less labour will be needed, whilst limiting the time of construction by 25 per cent.—*Motor Ship.*

Private Electricity Generating Stations.—The Federation of British Industries has recently had occasion to take up with the Electricity Commissioners the question of the establishment of private generating stations by manufacturers who wish to provide their own power supply. The position of such stations is indicated in *The Bulletin* for August 23rd. Under the Act there is no restriction on the establishment of a private station, provided that the owner thereof complies with any regulations made by the Electricity Commissioners as to the type of current, frequency, and pressure to be used. When standard regulations have been made for a district, a manufacturer putting down a station which complies with these regulations is not bound to notify the Commissioners, but it is strongly recommended that information should be given. If a manufacturer wishes to put down a plant of a type, frequency, and pressure of current not in accordance with the regulations, formal application *must* be made to the Commissioners for special regulations, but "such regulations shall be so framed as not to interfere with the economical and efficient working of the business for which the supply is generated." Until such regulations have been formulated in any area, there is no legal obligation to notify the Commissioners of the erection of any private generating station, but here again it is recommended that they should be notified, as the information will be helpful to them in framing regulations so that they will be acceptable to manufacturers. The Commissioners are confining their attention mainly to public utility undertakings, but nevertheless it is felt that they can be of great assistance to manufacturers on most matters connected with electric power supply.

ALIGNMENT PINS.

By A LONDON FOREMAN.

Alignment pins—called "steady" pins and "fixing" pins by shopmen—are brought into service in the erection of machinery details for the purpose of ensuring that one particular piece shall be superimposed upon another piece in its precise and correct position, no matter how many times the respective pieces may be separated.

Contrary to the methods of some engineers, who prefer fitting bolts to each and every hole, the writer much prefers clearance holes for the bolts, and precise and particular location made by alignment pins.

The latter method is much safer in respect of construction, for many who have used fitting bolts to each and every hole not infrequently wish they hadn't when things don't come just right in erection. It is then a case of filing holes to get things fair, and when fairness is secured the filed holes have more clearance than if clearance holes had been intended.

So clearance holes for holding the parts together let it be, and the only thing wanted is a good and endurable and well-looking alignment pin.

There are plenty of designs of steady pins, and all are applied in a similar way, for the continued and permanent alignment of structural details. The parts being fixed in position, and held securely together by bolts in clearance

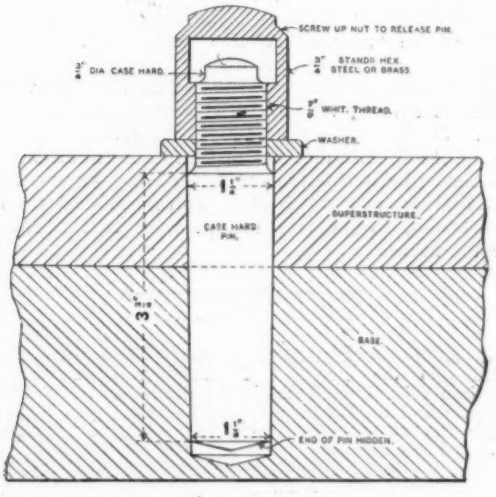


Fig. 1.—Alignment Pin.

holes, the holes for the alignment pins are drilled, in some cases drilled and reamed in others, and pins are turned and fitted in the holes provided. Besides making provision for placing the pins in the holes, provision must be made for conveniently getting the pins out of the holes, and without in any way distorting or damaging the pins during withdrawal.

Readers are familiar with the orthodox steady-pins—those which are driven in a taper hole and have to be drilled out. Others there are with heads (of a kind) which have to be levered out, and, more often than not, are bent badly in the process.

The pin shown in fig. 1 is the pin favoured by the writer, which has been used frequently at his suggestion in small engines, dynamo-electric machinery, and, notably, in the casings of large steam turbines, with unqualified success and approval.

It will be observed by those familiar with the use and application of these alignment pins, that a pin such as is shown in the sketch is all but imperatively necessary where it is necessary to fit it to a blind bottom, as represented above.

A FEW DOMESTIC ELECTRICAL "INVENTIONS."

By "VOLTMAN."

The writer's domestic electrical "inventions" were really the outcome of necessity during the dark days of the war. Strictly speaking, it was the dark nights that proved the truth of the proverb that "Necessity is the mother of invention." The control of the hall light was an early problem that had to be solved. It was desirable that the switch should not be used more than absolutely necessary, as the light, though reasonably shaded, acted as a magnet for the special constables on the beat if it were left on a couple of minutes. The switch, moreover, was most inconveniently placed to get at when entering the door, and when the house was in darkness it needed groping for.

The solution was a "brain wave"; it comprised an ordinary pear-push and a dozen feet of flexible which, luckily, were at hand. The flexible was easily wired to the back of the switch to form an extension in parallel, and the push served as an excellent switch that could not be left "on." The flexible was lightly stapled along the moulding, and brought so as to hang down just inside the door-post. Anyone entering had merely to press the push to light the hall and find his way in; he was not likely to leave the light on longer than he cared to keep his finger on the push. It was with some regret that the writer finally "demobilised" the contrivance, one which seems applicable to various cases where energy should not be wasted. Further arguments with the zealous "specials" led to the giving up of a ceiling light in one room and using a table lamp, but there was no wall plug, and making a permanent connection was too much work. No local shop could supply an adapter, and something had to be done. In a quarter of an hour an excellent adapter was made from a sound cork, fitting the pendant lampholder tightly, and a couple of french nails. These were carefully pushed through the cork, the flat heads serving as contacts to press against the plungers in the holder, and the projecting ends of the flexible were attached by a touch of solder, and given a turn of insulating tape. The cork was none the worse for having 230 volts across it, though the writer expected to find it charred to a cinder sooner or later!

Then came the "can't-buy-any-matches" period, a very trying time for the domestic *régime*. One day the writer, after a tour of a dozen shops, some of which displayed a notice "Please don't ask for matches," came to the conclusion that electricity could surely offer a way out of the difficulty. Two or three ideas came to mind, a platinum wire heated by a current from a small accumulator, a make-and-break spark to light the gas, but finally it was decided to utilise an old trembler coil which had seen better days on a motor-cycle. One was bought from a dealer in electrical "junk" for 7s. 6d., and rigged up on a base-board with a 4-volt accumulator, a push-button in the primary circuit, and a spark-gap of $\frac{3}{16}$ths. of an inch across the secondary. A better match substitute could not have been desired; one simply held a taper in the spark-gap and pressed the button, thus energising the coil and producing a spark. The coil easily earned its cost in matches and time, and the painful experience of being snubbed by the local shopkeepers never occurred again.

Electricity proves a valuable friend indeed in difficult times, and, given simple materials and thought to the essentials of a problem, there are many ways in which it can help in the household.

Illumination and Electrical Conductivity in Selenium.—Mr. A. O. Rankine, in the *Phil. Mag.* (May, 1920), gives a surprisingly good character to selenium cells for reliability within definite limits. "The effect of light on them is quantitatively reproducible again and again." Contrary to the tacitly accepted idea that the change of electrical conductivity in selenium is as the square root of the intensity of the incident light, it is claimed that extended experiments show the change to be proportional to the fourth root of the light intensity.—*Journal* of the Franklin Institute.

THE MUNICIPAL TRAMWAYS ASSOCIATION
(INCORPORATED).—I.

On Wednesday last the 19th annual conference of the Association was opened at Cardiff, a city which is enjoying a remarkable succession of society visits this year—the I.E.E. summer meeting, the British Association, the Municipal Tramways Association, and next week the Iron and Steel Institute. Coming late in the programme, the M.T.A. naturally finds the city authorities *au fait* with the duties and ceremonies which they perform so gracefully and hospitably, while it also has the advantage of arriving after the settlement of the strike of municipal employés which so sadly marred the visit of the British Association. The conference opened in bad weather, but the rain gave place to sunshine by mid-day. The city was full for the Horse Show.

The Executive Council held a private meeting at 10 o'clock, which was followed by a formal reception of the Association at the City Hall by the Lord Mayor, Councillor G. F. Forsdike, J.P., and the members of the Cardiff Corporation Tramways Committee. The conference was then opened at 11 o'clock by the President, Ald. Sir John W. Courtis, J.P.

The Lord Mayor welcomed the Association to Cardiff, and the president, Ald. Sir John W. Courtis, J.P., chairman of the Tramways Committee, suitably expressed thanks. He then opened the conference, mentioning in his address that that day was the fiftieth anniversary of the Tramways Act of 1870. He reviewed the march of progress since that date, and said that at the present time financial questions were of paramount importance. Passengers must all pay their fair shares of the wage awards. The work of the Whitley Councils, which was of the first importance, was then reviewed, and mention was made of the valuable work done by the Committee on Standardisation, especially with regard to overhead line materials. A special tribute was paid to the secretary's splendid work during the past year.

Papers on "Tramway Finance" were then read by Councillor Higham, chairman of Blackburn Corporation Tramways Committee, and Mr. P. Priestly, general manager of Liverpool Corporation Tramways; the authors agreed wholeheartedly in the view that upward revision of fares was inevitable if the undertakings were to be conducted on sound commercial lines, and that no class of passenger should be granted privileges in respect of fares. Abstracts of these papers are given below; the discussion will be reported in our next issue.

At 1 o'clock the conference adjourned for luncheon in the City Hall, at the invitation of the chairman and members of the Tramways Committee, 190 members being present, and on resuming the session at 2.30 p.m. a paper on "Operating Costs," by Mr. A. L. C. Fell, general manager of the L.C.C. Tramways, was read and discussed. In the evening a reception was held by the Lord Mayor and Lady Mayoress in the City Hall, and a pleasant evening was enjoyed.

On Thursday the programme included meetings of the Executive Council and of the Managers' Section, and the conference was to continue the discussion on "Tramway Finance" under the headings of "Repairs and Depreciation in Relation to Capital and Revenue" (papers by Messrs. J. Dalrymple, general manager of Glasgow Tramways, and R. L. Horsfield, general manager of Cardiff Tramways), and "The Future of Capital Expenditure" (paper by Mr. R. S. Pilcher, general manager, Edinburgh Tramways). The annual luncheon of the Association was to follow at the Royal Hotel, and in the afternoon the annual general meeting was to take place.

To-day is to be devoted to a pleasure excursion to Weston-super-Mare and Cheddar.

Tramway Fares.

By Councillor Higham (Chairman, Blackburn Tramways Committee.)

(Abstract.)

Postulate that tramway undertakings have to pay their way, and not be a burden upon the rates, then a proper adjustment of fares to meet the enormous increases in expenditure is essential. Wages and cost of materials have increased out of all proportion to the fares we have been charging, and, unfortunately, we are not able to hand on to our patrons the increases in the cost of producing rides (which is the commodity we sell) with the same facility as other industries. I am firmly of the opinion that tramways should pay their way, that the riders should pay for their rides, and with that end in view, every authority should adjust its fares to keep pace with the constantly increasing cost of labour, material, and money.

In most towns the time has arrived for the abolition of the penny fare. The first mile of your tramways from the centre of the system is in general the distance you have to depend upon most to make the undertaking a success, and if the people who use this portion are to escape all the increases in cost, how can you expect to get the necessary revenue out of those who travel the longer distances?—especially in view of the fact that in rush times you are most liable to have your cars crowded with penny fares to the exclusion of longer-distance passengers, and when the lower fares have quitted, you are very often left with a car-load of wind to the end of the route.

It will be generally conceded that a "workman's" fare is not a sound economic fare, and if this is the case, then part of the cost of carrying such "workmen" must be borne by someone else. I don't think anyone can argue that this is a fair, equitable, or rational state of things. When we had large classes of workmen receiving miserably low wages, there may have been some reason for subsidising the carrying of those who had to use the cars to get to their work, but now, if the amount of wages has to be taken into consideration, it is not the people who go to work before 8 a.m. who should have half-fares, but those who in the past have been looked upon as the aristocracy of labour, and go to their daily toil at 8.30 or 9 a.m. But I am firmly of opinion that there should be no subsidised fares for any class.

I see no reason why the tramway undertaking should be looked upon as a charitable institution any more than any other municipal undertaking. If it is logical that tramways should be used by some classes at cheaper rates than others, or entirely free, it is equally logical to ask for free gas, free electricity, and so on.

Tramway Fares.

By P. Priestly (General Manager, Liverpool Tramways.)

(Abstract.)

In dealing with the ordinary passenger fares, the rate stipulated in the Acts of Parliament prior to 1914 was usually fixed at 1d. per mile, but the operating costs have increased to such an extent, that many towns have had to obtain powers to increase the statutory fare from 1d. to 1½d. per mile, and in some cases to 2d. per mile. The majority of the larger undertakings which, prior to 1914, were not charging their full statutory fares, have found that it is impossible to make their tramway systems self-supporting unless the full statutory fares are charged.

The first consideration in connection with the operation of a tramway undertaking is that it should be run on a commercial basis; that it should produce an adequate financial return to the municipality to provide the community with a full service; and that it should accumulate sufficient funds for the renewal of the undertaking, as well as its improvement and extension.

It is clear that for a system to be remunerative the fares to be charged must be such as will bring in sufficient revenue to cover the whole of the costs, including capital charges, operating costs, renewals, &c. The fares charged ought to be laid out on an equitable basis, *i.e.*, each passenger should pay his share of the sum of the different items of expenditure.

One method is to arrange fares on a definite distance for the basic fare, and to charge the higher fares for the longer distances on this basis. Another method is for a high minimum and a low maximum fare to be adopted, which means that the short-distance passengers pay a much higher average fare than the long-distance passengers. This is of great importance in making a tramway undertaking of the greatest service to the community. It encourages people to live at longer distances from their work, and in healthier surroundings. It also tends to spread the population more evenly over the tramway system, and to diminish somewhat the tendency of the population to gravitate to the centre of a town, and cause congestion, with the result that the long-distance passenger is often crowded out by the short-distance rider. For

these reasons I am not in favour of giving short rides at low fares in the centre of the town.

I have arrived at the conclusion that the best method is to take a central point of the tramway undertaking as the town terminus, and from that point to divide the system into mile zones. It must then be ascertained at what cost a passenger can be carried for a mile, which amount must cover all charges; in other words, each passenger must pay the full cost of his ride. In some towns this amount has been found to be 1d. per mile, whilst other towns have had to make a minimum charge of 1½d. per mile. It might be found that some advantage could be gained by charging a slightly lower fare to the long-distance passenger, in which case the first zone would be a mile, and the next stages could be slightly increased in distance, so that passengers from, say, a five-mile radius would be able to travel to the central terminus for, say, a 4d. fare.

The running costs per car-mile are less as the car reaches the less thickly populated districts, when there are fewer stops, and the speed is increased, whilst the standing charges remain practically the same per passenger, making the total charge per passenger slightly less, and therefore a lower fare can be charged.

I think that the time has gone by when consideration should be given to splitting stages, *i.e.*, 1½d., 2½d., &c., fares, as these give rise to considerable difficulties in the collection of fares, and also give opportunities for passengers to avoid paying the correct fares, besides adding to the number of tickets which the conductor has to deal with.

As to overlapping stages, I am not generally in favour of them, except between the first and second 1d. stages, which do not extend outside the city area. The overlapping stages often encourage the business people to use the tramcars wherever they may be going within the business area.

With regard to the granting of special privileges, it is entirely wrong in principle that one class of passenger should have cheap fares at the expense of the other passengers.

Contract tickets are unworkable on a tramway system, and wherever these privileges have been introduced they have been in general abused. No preferential treatment should be given to any class of passenger. I am rather in favour of a system of higher fares being charged on special occasions, such as race meetings, football matches, &c., as a large number of people attending such meetings are strangers to the town, and only come there for that special purpose. They should, therefore, be charged higher fares in consideration of special cars having to be provided for their convenience.

I am entirely against the adoption of the transfer system, which is difficult to work, and, even when put into operation, has proved to be unsatisfactory.

The present operating costs make the serious consideration of the adoption of halfpenny fares impossible.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS FOR AUGUST, 1920.

The official returns of electrical export and import business for the month of August show a further falling off in the value of exports and a considerable appreciation in import values.

The total value of August electrical exports was £1,085,994, as compared with £1,166,798 in the previous month; the only branches of business attaining a higher level than in July were electrical goods and apparatus, meters, submarine telegraph and telephone cables and electrical machinery, whilst considerably reduced values were recorded in all other sections.

The imports total for the month of £284,572 was much in excess of the July figure of £237,498, considerable imports of carbons and machinery having entered this country in August.

The re-exports at £14,786 show an increase of nearly £2,000 on the July figures.

Values of Electrical Exports and Imports for Aug., 1920.—

	Exports.	Imports.	Re-exports.
Electrical goods and apparatus (unenumerated)	£196,711	£79,177	£5,666
Insulated wire	305,128	17,651	41
Glow lamps	28,534	4,615	249
Arc lamps and parts	1,144	2,552	434
Batteries	48,834	8,171	—
Meters	36,497	2,809	934
Carbons	3,505	16,094	2,895
Electrical machinery:—			
Railway and tramway motors ...	2,700	—	—
Other motors and generators ...	128,073	—	—
Electrical machinery (unenumerated)	67,191	136,728	2,098
Switchboards (not telegraph or telephone)	10,186	40	9
Telegraph and telephone cable and apparatus:—			
Telegraph and telephone wires and cables (not submarine) ...	76,474	3,519	24
Submarine telegraph and telephone cables	70,393	—	—
Telegraph and telephone instruments and apparatus	110,624	13,216	2,436
Totals... ...	£1,085,994	£284,572	£14,786

THE MACHINE-TOOL AND ENGINEERING EXHIBITION.

(*Continued from page 331.*)

Messrs. Charles Willetts, Jun., Ltd., Cradley Heath, Staffs., are exhibiting in addition to worm-gear lifting blocks, various small lifting appliances, jacks, &c., a quarter size working model of a direct-coupled electric passenger lift, which is operated by means of push-button control.

The Foster Instrument Co., Letchworth, Herts, most of whose instruments have, we believe, at one time or another been noticed in our pages, has a stand on which the following devices are to be seen:—

Foster's fixed-focus radiation pyrometers for measuring temperatures entirely from a distance, which are specially suitable for use with high-temperatures and inaccessible hot bodies; they are particularly convenient where the material remains in a furnace only a short time. The instruments are provided with a patented sighting device, and are made as light portable outfits, measuring in a few seconds, also as fixed recording pyrometers.

In the thermo-couple pyrometers for industrial heat treatment, special designs secure great robustness and simplicity, also cheap and quick replacement of the parts subjected to furnace heat. They are made as wall-type or portable indicating, and as fixed recording pyrometers.

Hoskin's alloy thermo-couple with head allowing quick attachment of wires, specially suitable for high-temperature measurement, and a Humfrey autographic (notched-bar testing machine for breaking metals, showing total energy absorbed in breaking, and also the manner in which the test-piece yielded, are exhibited, and are specially useful for determining correct specification and heat treatment of alloy steels.

An Eden-Foster repeated impact testing machine for testing resistance of metals to "fatigue"; a Foster strainmeter for measuring strains of loaded structures, together with a variable speed friction drive, are shown. A point to be remembered in connection with this firm's stand is that every exhibit is shown actually working.

Messrs. Vickers, Ltd., London.—This stand gives an idea of the variety of products turned out by the firm's works. For instance, there are on view test pieces of steel, tubes, cast propellers, drop stampings, &c., in addition to such things as rifles and shot-gun tubes, hydraulic valves, variable-speed gears, refrigerating plant, agricultural machinery, rubber products, sewing machines, and toys. The small winding engine that is shown is intended to illustrate the great advantages obtainable by the application of the Williams-Janney gear to all duties where continually-varying loads are met with or speed control is desirable. The winder consists of a small cylindrical drum of about 2 ft. diameter, running at 30 r.p.m. and driven through double-reduction gearing, and a size 20-type "C" Williams-Janney gear directly coupled to a continuous-running 20-h.p. 500-r.p.m. electric motor. The winding engine is provided with the usual standard driver's control lever and foot-operated brake. The chief advantages of the Williams-Janney gear briefly are:—That it provides an indefinitely variable-speed regulation in both directions, and enables a constantly-running prime mover to be employed by an intermittently-running machine; the electrical equipment and wiring are simple; the heavy resistance losses during starting and slow-speed running met with in the ordinary rheostatic control, are eliminated. Also that the prime mover is started up under light load conditions; the load is taken by the prime mover as and when required; each position of the driver's control lever corresponds to a definite winding speed; and the overall efficiency of the plant is high.

The Cambridge and Paul Instrument Co., Ltd., London.—The principal features of this exhibit, which comprises a large selection of the firm's well-known scientific instruments, are the electrical CO_2 recorders and indicators. They are made in a number of forms for either indicating or recording, or both, from one or a number of different points simultaneously. The principle of the Shakespear device, which requires no chemical absorbent, has already been described in our columns, but a new instrument is displayed for the first time. It is known as the Chimney Loss Indicator, and its function is to show at one and the same time the percentage of CO_2 in the flue gases, the flue-gas temperature, and also the approximate loss of efficiency. The apparatus takes the form of a combined electrical CO_2 recorder and a standard thermo-couple thermometer. One dial face serves for the scales of both instruments; the two scales curve upwards from the two bottom corners, forming the sides of a triangle, and the pointers are pivoted to the right and left of the base line, which is calibrated to show the corresponding loss of efficiency for any two values of CO_2 and temperature. The reading on the third scale is taken from the point where the two pointers intersect, the graduations being continued upwards from the scale to facilitate reading. Another interesting feature of the exhibit is the new totally-enclosed indicator and switchboard for use with electrical distance thermometers. The indicator was originally designed for use on board ship, but it is equally suitable for use in damp or dirty situations on land. The most modern type of this device can be supplied for 12, 24, 34, 70, or 150 points. A third new exhibit is a three-thread recorder, being a development of the standard two-thread type. Each thread gives a reading every 2·5 minutes, with half-minute intervals between the records of each thread. With regard to the rest of the exhibits, resistance pyrometers include a Callendar recorder, Whipple indicator, and resistance thermometer. Combined indicating and recording electrical distance thermometer outfit, consisting of a double-range indicator with 20-point switch-

board, four-point recorder and resistance thermometers. A twelve-point indicating outfit, as supplied to cold stores, totally enclosed moisture-proof indicators, double-pivoted thread recorder, and resistance thermometers for marine use. Various patterns of thermo-electric pyrometers, indicators, switchboards, recorders, rare and base metal thermo-couples and accessories. Complete double-range indicating outfit for taking molten metal temperatures, and a complete twelve-point indicating outfit with special copper-constantan thermo-couples for taking temperatures of armature windings; an electrical locomotive pyrometer, radiation and optical pyrometers, mercury-in-steel thermometers, and dial thermometers, vapour tension types in various patterns; also mercury-in-glass thermometers, draught and pressure gauges, and electrical instruments, including resistance bridges, potentiometers, unipivot galvanometers, Irwin astatic dynamometer wattmeter, testing sets, &c.

Messrs. G. Swift & Sons, Ltd., Halifax.—To illustrate the various types of electrically-driven machine tools that are on view, the following examples are appropriate. The illustration, fig. 15, shows a 10-in. centre all-geared head-lathe driven by a B.T.H., 15-H.P., D.C., constant-speed motor working at a pressure of 220 volts. The drive from the motor to the gear box is by raw-hide pinion, and a friction drive between the motor and the gear box allows of gear changes being easily made without stopping the motor. There are 16 spindle speeds, controlled by three levers, and it is impossible to engage conflicting sets of gear; there are six changes of feed, driven by a feed box of the sliding-wheel type, and a double-walled apron is fitted to the saddle with drop worm for engaging the feeds. The machine admits between centres 6 ft. 6 in., swings over saddle 14·5 in. diameter; swings in gap 37·5 in diameter, 10·5 in. wide, and its weight is 95 cwt.

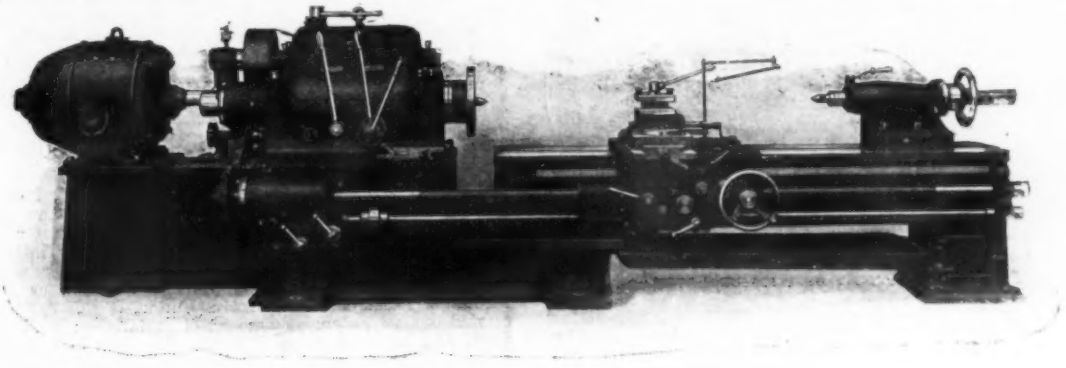
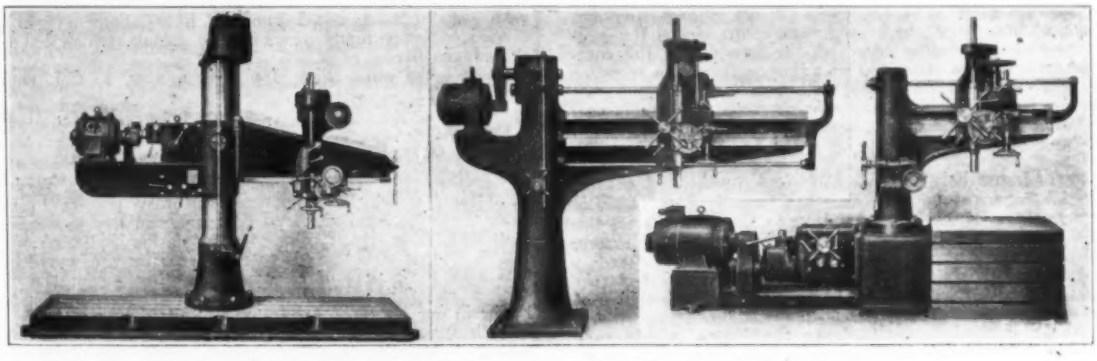


Fig. 15.—Motor-driven All-geared Head Lathe.

Central-thrust radial drilling machines are built with direct motor drive on the arm, as illustrated in fig. 16, and with double, triple, or quadruple base plates as required; they are made in three sizes, 5, 6, and 7 ft. radius. Fig. 17 shows a girder radial-drilling machine fitted with a three-speed gear box and motor drive on the arm, while fig. 18 shows a machine between the gear box and motor of which a friction clutch is placed to allow the machine to be stopped independent of the motor, and to facilitate changing speeds in the gear box.



Figs. 16, 17, and 18.—Electrically-driven Drilling Machines.

Messrs. Crossley & Co. [C. W. B. Crossley], Manchester. In addition to a comprehensive display of machine tools, a selection of portable electrically-driven tools, including drills and grinders for hand and bench use, are on view on this stand.

Messrs. Unchokeable Pump, Ltd., London, exhibit a remarkable type of centrifugal pump, the impossibility of choking which is claimed to be an actual fact, and is guaranteed. A 6-in. pump direct driven by an electric motor is shown; pumps of this form are made with either horizontal or vertical spindles, and they are also suitable for belt or high-speed internal combustion engine drive. The following is an extract from a report by Prof. J. Goodman, M.I.C.E., M.I.M.E., to the owners of the pump patent:—. . . "It ran perfectly without the slightest sign of choking when supplied with barrow loads of long stringy river weeds, straw, hay, rope, bundles of frayed hempen rope, belting, ashes and clinkers." . . . "The mechanical efficiency of this pump is not high as compared with pumps specially designed to give the best possible efficiency with clean water—but, in my opinion, the mechanical efficiency is of secondary importance when dealing with fibrous materials which are liable to choke a pump—the loss of time and money involved in having to constantly stop and clear away obstructions far outbalances any slight advantage due to an increase in mechanical efficiency. I, therefore, consider that your pump, which has only a moderately good mechanical efficiency, but is absolutely foolproof and capable of passing long fibrous materials, and solid matter, is of far greater value to those who have such materials to deal with than a high-efficiency pump which will constantly require attention."

Messrs. Reavell & Co., Ltd., Ipswich, have two sets of air-compressing plant amongst their working exhibits that should be of interest to electrical men. The first is a duplex compressor jockey pulley driven from an electric motor, and consists of a duplex compressor, with a piston displacement of 50 cu. ft., and a working pressure of 100 lb. per sq. in., and is specially suitable for supplying air for pneumatic tools. This exhibit is controlled by means of an automatic starting and stopping switch. The second set is a sub-station cleaning outfit, and consists of a Reavell patent sub-station compressor direct coupled to a small D.C. motor, and provided with a hose on a drum, starting switch, and wall plug with a flexible cable. This set demonstrates the use of compressed air at low pressure for cleaning the dust from electrical machinery, &c. A small rotary compressor, and a large rotary compressor which are on view, have been recently introduced, and are suitable for capacities of from 100 to 2,500 cu. ft. per minute, and are designed to compress air to 10 to 15 lb. per sq. in. gauge, and at the same time may be run at a speed sufficiently high to allow of direct coupling to electric motors of standard speeds. The machines are of the familiar "Crescent" type, consisting of a drum fitted with a number of slots in which steel blades slide in a radial direction. When running the centrifugal force created in the blades, forces them outwards against a liner, and the friction produced by the blades against the liner is sufficient to overcome the slight frictional resistance of the revolving liner: the latter, therefore, revolves freely with the drum or rotor. Large numbers of the smallest size of these machines were supplied to the Royal Air Force for special purposes, being driven by an air screw up to speeds of 3,000 R.P.M. The larger type of machine exhibited is one of a number supplied to the British Admiralty for exhausting the water from the ballast tanks of submarines. There are also on the stand several machines of the "Axial" type, some of them with water jackets, for pressures up to 60 lb. per sq. in., and several unjacketed machines for pressures up to 20 lb. per sq. in.

These machines are largely used for supplying the blast air to oil-fuel burners.

Messrs. Smith, Baker & Willson, Ltd., Halifax.—An innovation in machine-tool lay-out is to be seen on this firm's stand. It will be noted that the battery of lathes shown in fig. 19 is driven by means of the live shaft, seen on the left-hand side of the picture, which runs the whole length of the shop, or in sections, as desired. This uncommon arrangement intends the lathes to be run in gangs of 10 or more, and they can be driven in an open shop under a crane, as there are no overhead countershaft or fittings of

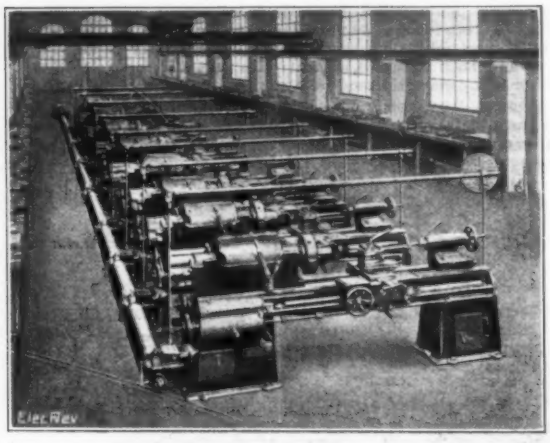


Fig. 19.—A Battery of Willson Lathes.

any description. Power is transmitted from the driving motor by means of a silent worm drive, through a friction clutch, to the driving gears, which, by sliding upon a castellated shaft in the leg, give four changes of speed, the final drive being by belt to a single pulley in the headstock. Two rates of back gearing are provided, which may be instantly changed with the aid of friction clutches, giving 12 spindle speeds; reverse and "knock-off" motions are also provided.

(To be continued.)

The "Fahrdiagraph."—This recorder is stated to be a simple, accurate, and convenient means for obtaining automatically the so-called "running diagram" in railway work, and also other similar diagrams, such as temperature variation curves on loaded electrical machinery, oscillation charts, &c. It can also be used to indicate the integral curves of given general curves, for the conversion of given mathematical relations, &c. A full account of the theory and operation of the recorder is given in *Elektrische Kraft-betriebe und Bahuen*. There are two plane charts and one drum chart, the preliminary diagrams being traced on the former and the combined curve on the latter. The adjustment of the recorder for any given operation is said to be quite simple and only to take a few minutes, as the moving parts are simple and few. The apparatus is protected by German patent No. 286,519.—*Technical Review.*

X-ray Finger Prints.—An improved method of taking criminals' finger-prints by X-rays has been invented by Dr. Henry Beclere, of Paris. According to the daily Press, the process consists of rubbing the ends of the fingers with some chemical which is opaque to X-rays. On being X-rayed a photograph of the finger-tip, like an ink thumb-print, is obtained, only with much greater accuracy; and it is capable of being enlarged with greater precision for examination. Moreover, the X-ray photograph shows the bones, which vary slightly in different individuals' fingers, and the internal shape of the nails, which is also a varying characteristic. Thus each photograph contains matter for identification in three different ways.

Rectifier for Small Currents.—At a meeting of the German Electrotechnical Association a type of rectifier was described that is suited for supplying very small currents of the order of from 0.5 to 3.0 amps. According to *E.T.Z.*, the rectifier consists of a bulb containing a gas such as argon, and provided with cathodes of metals that can be easily volatilised, such as thallium, alloyed with heavy metals such as mercury, cadmium, or lead. Cathodes of such alloys have the property of maintaining a stable arc with far lower currents than mercury cathodes. The apparatus is connected in a manner similar to a mercury vapour rectifier, with the exception of the starting gear, which is a vacuum interrupter connected in parallel with one of the two circuits of the rectifying tube. The efficiency of tubes of 30 to 100 watts capacity is about 65 per cent.—*Technical Review.*

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Road Transport.

I note in your issue of the 3rd inst. that the Institute of Transport is to consist of members who have had some considerable experience in dealing with traffic, or providing transport, or works connected therewith, and those who have consented to become members of the Council—a list of whom is given in your issue—have all apparently been connected with traffic and transport work.

With the exception of Sir H. P. Maybury, I fail, however, to find the names of any who are acquainted, for instance, with modern road work, and unless more attention is given to the science and art of road construction for present-day traffic, those who are responsible for providing transport and dealing with road traffic are, in my opinion, likely to have some difficulty in the smooth running of the heavy and increasing motor traffic that the roads will have to carry.

It looks to me as if the Institute of Transport is putting the cart before the horse.

Tractor.

September 7th, 1920.

Why is the Contractor Permitted to do it?

The letter of Mr. Charles A. Baker in your current issue, and that of a previous correspondent, raise a very interesting point to all contractors. Personally speaking, I have always understood (but never had it legally confirmed) that a supply company has no right to refuse to connect any installation on whatever system it has been carried out, provided, as Mr. Baker says, it comes up to the standard as regards insulation resistance. Now, Mr. Editor, *is this so*? I have carried out an enormous amount of installation work in my time, and have on more occasions than one had connection refused on account of "slip-jointed" conduit and fittings being used. Now, if this class of material is not allowed, why are such large quantities turned out by the manufacturers? It is not my point herein to advocate or to condemn the use of slip-jointed conduit and fittings, but it is time some final decision was given, as it is, to say the least, very unfair to insist on one contractor installing "continuity tubing" in a district where other installations have been executed and connected with "all sorts and conditions" of wiring.

I have always been an advocate of a good sound job, whatever the system employed, but fail to see why slip-jointed tubing should be condemned, provided the same has been *properly installed*. Likewise, I fail to see the use of earthing the section or length of tubing nearest the supply authorities' fuse box, this being usually insisted on, together with, of course, ironclad switchgear, &c.

I well remember the noise that was made when slip-jointed conduit first commenced to supersede wood casing, and all sorts of statements were made about the "risk of fire," &c., with wood casing, but I know of installations still in use, carried out very many years ago in casing, which have not yet caught fire.

Doesn't the same thing apply, in a way, to C.J. conduit and fittings?

S. O. Hoad.

Eastbourne.
September 13th, 1920.

[Certainly it is so. Supply authorities (with a very few exceptions, which have obtained statutory powers to make rules) have no legal right to criticise, still less to condemn, any installation which passes the insulation test, unless they can show that if connected to the mains its use would interfere with the supply of electricity to other consumers. This subject was fully dealt with in an article by Mr. Chas. A. Baker in our issues of April 18th and 25th, 1919.

With regard to other points in the letter, our correspondent will find Mr. Wordingham's article on p. 357 of this issue interesting.—Eds. Elec. Rev.]

The E.P.E.A. and The E.T.U.

It has come to our knowledge that a principle of the highest importance is now at stake, which, if accepted, would destroy the independence of the Electrical Power Engineers' Association and cause it, in fact, to be merely (in the matter of votes) an inferior section of the Electrical Trades Union.

It has been publicly stated by the Secretary of the Electrical Power Engineers' Association that it has been decided in the present dispute between the Electrical Trades Union and the Engineering Employers' Federation to throw our weight in with the side which agrees to arbitration—in this case with the Electrical Trades Union.

It has, however, been overlooked that the dispute was precipitated by the action of the Electrical Trades Union at Penistone, which is now prepared to refer the case to arbitration. With the merits of this dispute the electric supply industry has nothing whatever to do.

It has also come to our knowledge that the Executive Council of the Electrical Power Engineers' Association holds the view that because we are a trade union we must throw in our lot with *any other* trade union in any strike that may develop, provided the grounds seem to us to be just. In other words, we declare beforehand our sympathy with the men as against the employers.

We, the undersigned, cannot accept so radical an alteration in the policy first enunciated by the Electrical Power Engineers' Association, or so drastic a *forfeiture of our independence*, and we cannot believe that the vast body of the more intelligent and highly-trained engineers in the electrical profession can accept it either.

It should be borne in mind that the senior power engineers have, in many cases, given their support to this (Electrical Power Engineers' Association) movement largely to improve the status and remuneration of the junior members. Under the proposed new scale of salaries the junior members have benefited far more than the senior members.

We consider that the Institution of Electrical Engineers is also vitally interested in this question. Mr. C. H. Wordingham, as President, strongly advocated the formation of the Electrical Power Engineers' Association, and we then understood that it was to be conducted on lines very different to those that are now being adopted.

If the more responsible members of the Electrical Power Engineers' Association would make their voices heard, and would refuse to be coerced into actions that they disapprove of, it might not yet be too late to save the situation.

A Group of Senior Power Engineers.

September 14th, 1920.

Power Factor.

I am sure it is clear from my previous comments that I did not misunderstand the purpose of Mr. Turnbull's article, and I still think that the conversation I suggested with the unlearned consumer would do more to clear his—or her—ideas than Mr. Turnbull's method would. I suggest that he read the last paragraph of my comments to some business man, to put the point to the test, and that he report the result. The advantage of my plan is that it never mentions power factor or wattless currents at all, and so there is no need to try to do what Mr. Turnbull says the text-books do not do, namely, explain these "elusive" entities to the —presumably, at the end of the explanation, gaping—consumer. The impression I obtained from Mr. Turnbull's first article was that he wished everyone to aim at unity power factor, and that consumers should be asked to bear the cost of the improvement. With that I heartily disagree. Alternating-current distribution is obviously advantageous, as a whole, to supply authorities, otherwise they would not have adopted it. Wattless current is one of the disadvantages of the type of supply; that is all. The true aspect of the matter is, as I indicated very briefly last time, just this: If any consumer is taking current at an abnormally low power factor, he should pay more for each unit he uses than a consumer who works at round about the average power factor of the system, and, correspondingly, anyone working at an exceptionally high power factor should be compensated by the supply authority, as Mr. Turnbull now suggests. I am sorry if I missed that meaning in Mr. Turnbull's first article, but I cannot see it there even yet. Perhaps it is another example of the student and the text-book.

Suppose, for example, that one factory finds it convenient to use a number of individual drives with small motors, while another finds it better to use one large motor for each section or shop. The power factor of the former installation will clearly tend to be worse than that of the latter, if both sets of motors are equally loaded in proportion to their full output, and I agree that it may be fair to say to the user of the individual drives that part of the cost of his convenience must be a slightly higher cost of each unit he purchases from the supply authority. But to go to both consumers and say they must at their own expense improve their power factor to unity would be absurd. They know, if they understand the matter at all, that if they take electricity not at unity power factor the supply authority will look after its own interests by charging them accordingly. If the level of power factor is fairly uniform all round, and the supply authority wants to connect a number of additional consumers, but cannot do so because the limit of the capacity of its station is reached, then it might begin to argue for a general raising of power factor, but not till then. And even then the supply authority would have to realise that it, too, is part of the co-operative concern, and be prepared to pay at least part of the cost of procuring its own larger output. Until that extreme emergency occurs, let the general level of consumers pay at a rate which is just to them and to the supply authority, and let all unfairness be avoided by adopting, in the case of specially low-power-factor installations, one of the methods available for power-factor improvement.

Strictly speaking, the matter ought to be carried much further, and a consumer ought to be judged by the useful horse-power output he manages to extract per ampere at a given pressure of supply. This would carry the problem over to direct-current motors as well as alternating-current motors. What must be done is to see that no consumer is unfair to others. Let the highly skilled and fully instructed (whether from text-books or not does not seem to matter much) station engineer decide what is a fair power factor and efficiency for each consumer, and charge all alike so long as they do not perform materially worse than might be expected. If they do, then, and only then, go and reason with them, and touch their hearts with piteous appeals, and tales of how they are interfering with their neighbours' comfort.

What I thought wrong in Mr. Turnbull's statement about increased cost of plant due to low power factor I still think wrong. He said that 50 per cent. power factor meant something like a doubling of cost of supply plant. Mr. Turnbull is very severe on professors and text-books for their lack of clarity and want of frankness; let him be at least reasonably accurate himself! It is very interesting to hear of a switch costing £5,000, but that has no bearing at all on the point of comparative costs.

I have carefully read Mr. Turnbull's explanation of lagging current and of power factor. It does not contain anything with which those of us who have had to depend mainly on text-books are not already perfectly familiar, so that the text-books are not, perhaps, so dreadfully defective after all. It seems to be necessary to protest again when Mr. Turnbull says that the current is not all "effective," and to point out that the wattless current he so much hates is absolutely essential to the motor, because without the flux produced by it the motor would have no torque, and would not be a motor at all. And let me repeat, even *ad nauseam*, that wattless current is *not* supplied free; it is most distinctly paid for in every case—provided, of course, that the consumer is an honest man, and pays his bills. I do not suppose Mr. Turnbull meant to suggest anything to the contrary.

I am not impressed by the extract from Glover's Almanac, because it fails to state the relative importance of the saving to the total output of the station in question, and it fails to state the net saving in cost when the expense of installing the condenser is taken into account. We all know, of course, that power factor is a nuisance, but so is money, and so, for that matter, is life; yet we must put up with these things, and try to see them fairly and, as a whole, in proper perspective. Did anyone—certainly I did not—ever say that wattless current is either wasteless or costless?

If Mr. Turnbull is going to talk about current factor instead of power factor, let him take efficiency into account as well, and he will perhaps arrive at results that show that the much-belauded direct current is not necessarily so very "respectable" after all.

The Same Correspondent.

August 29th, 1920.

May I be allowed to comment on Mr. C. H. Harvey's letter under this heading published in your issue of the 10th inst., as I am sure it will be helpful to your readers to promote a discussion on the subject of power factor, and it is to be hoped especially that engineers in supply undertakings will express their views.

Mr. Harvey suggests charging on K.V.A. demand only (presumably K.V.A.-hours), but I cannot see that this is any more sound than to charge on KW. only or units, as the total cost in the supply of electrical energy is not directly proportional to the kilowatt-hours nor to the kilovolt-ampere-hours, but is some point between the two, depending on the conditions of supply and the nature of the load.

Whilst it is not sound to charge on kilowatt-hours only—which will often benefit the consumer, especially those of low-power-factor load—it cannot be argued that to charge on K.V.A.-hours would be just to all consumers, as in this case the boot would be on the other foot, and would be to the advantage of the supply undertaking.

To demonstrate the injustice of such a charge let us assume that the consumers of an undertaking are charged at a flat rate of 1d. per K.V.A.-hour. The consumer with a load of 100 KW. at unity P.F. would therefore pay 100d. per hour, whereas a consumer with 100 KW. load at 0.6 P.F. would pay 167d. per hour. In the first case the whole of the supply undertaking's plant is used to full advantage, but in the second instance, although the prime movers and boilers for all practical purposes would have the same load, the alternators, mains, transformers, &c., would have to carry an additional 67 K.V.A.

The 60 per cent. P.F. consumer is paying 167d. per hour, and could, therefore, take 167 KW. at unity P.F. for 167d., *i.e.*, the same amount. It is obvious, therefore, that something is amiss, as by keeping his demand in K.V.A. at the same figure and raising the power factor to unity he would actually get an additional 67 KW. of true energy or 67 units per hour at the same total cost; or, to put it another way, if he paid the supply undertaking on the basis of 167d. per hour for 100 KW. at 60 per cent. P.F., the supply authority would get out of paying for the generation cost of 67 KW. of true energy. Whilst this would perhaps be a very happy state of affairs for the supply authority, it can hardly be considered a very favourable outlook for the consumer. A more equitable state of affairs would be obtained if consumers were charged on the reading of an integrating meter recording, say, two-thirds kilowatt-hours and one-third K.V.A.-hours, and such meters have actually been built, and were

invented by Prof. Arnó. This proposition as near as anything approaches in simple form an equitable basis of charge, if, when designing the meter, the proportion of true units and apparent units is adjusted to suit the particular undertaking. On the other hand, to get down to basic conditions, the only method by which the consumer can be equitably charged is on K.V.A. demand as a plant rental charge and unit charge for energy. In determining the plant rental charge due consideration can be given to that portion of the plant which is unaffected by power factor.

E. W. Dorey.

Enfield.
September 14th, 1920.

I quite agree with Mr. C. H. Harvey when he says in his letter on power factor, in your issue of the 10th instant, that it is difficult to follow the actions of alternating currents in our minds. Might I suggest, however, that the difficulty is greatly increased by the use of the term "wattless current?" What, may I ask, is the origin of this term? If, for purposes of investigation, we consider an alternating current as being split up into two components, one in phase with the E.M.F. and the other 90 deg. out of phase, we are quite in order in referring to the latter as the "idle" or "wattless" component of the current.

This, however, is a vastly different matter to recognising the existence of a separate wattless current or even of that "extra" current, by which, according to Mr. Harvey, "the current is increased at all times, &c."

To add still further to the mystery surrounding this weird current, he goes on to tell us that it comes from nowhere; at least, it "takes no power from the generator," it "causes heat losses," and it "circulates through low-resistance windings, maintaining a magnetic flux."

I am afraid that Mr. Harvey's hopes of clearing the matter by this "explanation" are doomed to disappointment. I would strongly advise him to banish entirely from his mind "wattless current" as a term that has no significance.

Mr. Dorey strikes the right note in his letter on the subject when he speaks of the "wattless leading component," although in this case of power.

"Wattless component" whether of current, E.M.F., or power, is a legitimate expression, of value in its right place, but "wattless current" has no place, and its use should be avoided.

If we plot two curves representing E.M.F. and current in an A.C. circuit, and then plot a third whose ordinates are the products of the ordinates of the first two at corresponding instants of time, and in volts and amperes respectively this third curve will represent power in watts.

If our E.M.F. and current curves are out of phase, parts of the power curve will be of opposite sign to the remainder, owing to the E.M.F. and current being of different signs at those times.

Now, the mean power throughout a period is the average value of all the ordinates of the power curve, *due regard being paid to sign*; and a very little consideration will show that when the E.M.F. and current are in phase, the mean power will be the greatest for given values of these quantities.

On the other hand, when a phase difference of 90 deg. exists, the mean power, as defined above, will be zero, intermediate angles of phase difference giving varying values of mean power between these two extremes.

The above is, in brief outline, a method of explaining P.F., which should be understood without difficulty by anyone who can grasp the fact that the E.M.F.'s and currents really do alternate.

The power curve should be plotted on a separate base line, as this emphasises the negative parts of it; and to prevent confusion with the lower halves of the E.M.F. and current curves, which are sometimes erroneously called their negative halves.

This method of explanation may be elaborated to any degree in accordance with the capacity of the person being instructed, but I have endeavoured to show, in a plain way, how this puzzling subject may be approached without the use of, usually, still more puzzling analogies and misleading terms like "wattless current."

E. Freeman Smith.

Dunfermline.
September 12th, 1920.

Engineers' Salaries.

In a recent issue of the Review I noticed an advertisement for an engineer which stated "University training preferred." The salary offered was little more than a bricklayer's. I consider it is high time that such adverts disappeared from any "situations vacant" column. It would be very interesting to know the percentage of advertisers who have the qualifications they expect from applicants.

Disgusted.

September 11th, 1920.

[We are surprised that our correspondent is not content with a salary that is "more than a bricklayer's." Does he want the earth?—Eds. Elec. Rev.]

BUSINESS NOTES.

Bankruptcy Proceedings.—W. T. Smith, electrical and mechanical engineer, Victoria Street, and 60, Hampden Street, Bolton.—Last day for proofs for dividend, September 25th. Trustee, Mr. J. G. Gibson, Official Receiver, Byrom Street, Manchester.

Bernard Esmond Thomas, 12, Castle Meadow, Norwich, electrical engineer. This public examination took place on September 13th, at Shire Hall, Norwich. Debtor returned his gross liabilities at £2,087, of which £2,035 were expected to rank. His assets were estimated to produce £380, leaving a deficiency of £1,655. Debtor attributed his failure to taking work at too low a price; the employment of inexperienced electricians; and want of knowledge of business methods. He started business in Norwich in September, 1919, with a capital of £280, and his unsecured liabilities included £1,650 in respect of loans. He stated that the money received in respect of these loans had been put into the business and in speculating in motor cars. He had drawn from £4 to £6 a week for his own expenses. The examination was closed.

Trade Announcements.—Owing to continual expansion the Cambridge and Paul Instrument Co., Ltd., have decided to centralise their business organisation in London, and they have established head offices and showrooms at 45, Grosvenor Place, S.W. 1. (Telephone: Victoria 7640). Users will be welcomed at these showrooms, which will contain a wide and varied selection of instruments, both scientific and industrial. A permanent exhibition of this nature is expected to make a wide appeal, as it will be convenient both for the foreign visitor on a tour of inspection, and also for the prospective buyer in this country, as they will be able to inspect apparatus in which they are interested, before purchasing.

Mr. Woodland B. Erlebach is starting in business as an electrical engineer and contractor at 5A, Cork Street, Old Bond Street, W., and he desires to receive manufacturers' catalogues and price lists.

Mr. J. Martin, electrician, has opened premises at 14, High Street, Dover.

The Holland House Electrical Co., Ltd., of 58, West Regent Street, Glasgow, is about to resume trading.

Mr G. H. Jamison, of 145, Wool Exchange, London, E.C. 2, has taken up in this country the representation of La Metallogravure, a French concern which makes a special line of the production of chemically-engraved name and address plates for attaching to machinery and instruments. The works at Asnières have an output of 80,000 plates per day, including many for use on electric motors, meters, precision instruments, automobiles, &c.; we have inspected a collection of name-plates in various metals, designs and colourings. We understand that prompt deliveries can be given on this side.

Messrs. A. & E. Lower, of 668 and 670, Seven Sisters Road, South Tottenham, N. 15, have started an electrical branch to their works, under the management of Mr Albert J. Lower. Trade catalogues, show cards, &c., are desired.

The Western Electric Co., Ltd., have appointed as their sole agents for Portugal, A Empreza Electrica Lusitana, Ltd., Rua da Conceiçao, 153, 1°, Lisbon, and Rua Ferreira Borges, 14, 1°, Oporto.

Catalogues and Lists.—Messrs. H. Tinsley & Co., Werndee Hall, South Norwood, S.E. 25.—List No. 3 (8 pp.), describing and illustrating a vernier potentiometer of new design, and also accessories. Fully priced.

The Sun Electrical Co., Ltd., 118 and 120, Charing Cross Road, W.C. 2.—A fully-priced catalogue (No. 309) of electric cables and wires, consisting of sections dealing with V.I.R. cables, tough rubber cables, flexibles, and bell and telephone wires. Also a leaflet (No. 310) describing and illustrating the "Apex," a new departure in ironclad switchgear.

Messrs. Siemens Bros. & Co., Ltd., Palace Place Mansions, Kensington Court, W. 8.—Pamphlet A 550, "Wireless Telegraphy for Ships" (20 pp.) A publication dealing with Siemens quenched-spark system and standard spark sets. The booklet is well illustrated, and includes photographs of complete cabinet-type stations for small vessels.

Mr. S. H. Rawlings, 9, Victoria Street, S.W. 1.—Leaflet illustrating and describing the "Tank" box, made of strong tin-plate with leather handle and straps. Priced.

Messrs. White, Jacoby & Co., Ltd., Bayham Place, Camden Town, N.W. 1.—A collection of illustrated leaflets dealing with electric drills, reamers and blowers, magnetic chucks, &c., chiefly for D.C.

The Oxford Educational Films Supplies Co., Ltd., 439-441, Oxford Street, W. 1.—Illustrated leaflet giving a full description of the functions of the "Oxford" portable kinema projector, which is being used by many large industrial firms for the display of motion pictures of their products.

Company Liquidations. — Commercial Electrical Accessories, Ltd., Diana Place, Euston Road, London, N.W. 1.—In pursuance of Sec. 188 of the Companies (Consolidation) Act, a meeting of the creditors of the above was held on September 10th at the Institute of Chartered Accountants, Moorgate Street, E.C. The chair was occupied by Mr. Norman Bell, who had been appointed by the shareholders to act as liquidator in the voluntary liquidation of the company. The chairman said that the company was a private limited liability concern, which was registered on July 29th of last year. It was formed to take over a business of wholesale and export electrical supplies formerly carried on by Messrs. Tredegars, Ltd., of Brook Street. The company took over the business as from April 1st, 1919. It had a capital of £20,000, divided into 10,000 7 per cent. cumulative participating preference shares, and 10,000 ordinary shares, all of the face value of £1 each. The original issue was 9,000 ordinary shares, and 4,998 preference shares, which were allotted to Messrs. Tredegars for the assets they transferred. Since that date, 1,902 preference shares had been issued for cash. During last year there was a big expansion in the business, and steps were taken to further extend operations by the assembling of electrical goods. The arrangements were fairly well in hand, when a disaster overtook the company by the death of Mr. A. Bartlett, one of the directors, who was drowned at sea while crossing to Brussels on business. As a result, the arrangements for the introduction of further capital fell through. Other attempts were made to introduce further capital in order to extend the business, but they were not successful. In May of the present year, the agreement with the managing director came to an end, and finally the present voluntary liquidation was decided upon. As liquidator he had entered into negotiation for the sale of the business as a going concern. If those negotiations fell through, there were other people who were willing to consider the proposition. The assets would be sufficient not only to pay the creditors' claims in full, but to leave a substantial margin over for the shareholders. The liabilities amounted to £4,971, while the assets, exclusive of the goodwill, were valued at £7,077. The stock in trade had been valued at cost, while the book debts, which were of the face value of £3,300, had been written down to £1,800. Mr. Oliver Sunderland enquired if the accounts of the company showed a profit. The chairman replied that at the end of March there was a profit shown subject to the expenses in connection with certain litigation and bad debts. After allowing for those expenses, the trading showed a loss. He added that it was a good saleable stock, and generally speaking, the prices of most of the lines were on the up grade. The position was shortly discussed, and eventually it was decided that an application should be made to the Court for the appointment of Mr. W. Osborne, of Messrs. Corfield & Cripwell, Balfour House, Finsbury Pavement, E.C., to act as joint liquidator with the chairman, while a committee of three of the principal creditors was also nominated. It was also understood that if the negotiations for the sale of the business were carried through within the next 10 days, then the application to the Court for the joint appointment would not be proceeded with.

British Gauge Manufacturers' Association, Ltd.—Meeting called for October 8th at 1, 2 and 3, Oxford Court, Cannon Street, E.C., to hear an account of the winding-up from the liquidator, Mr. B. G. Arthur.

Wensleydale Gas and Electricity Co., Ltd.—Meeting October 19th, at 7, Greek Street, Leeds, to hear an account of the winding-up from the liquidator, Mr. C. H. Wilson.

Renew Electric Lamp Co., Ltd.—Meeting October 14th, at 5, Chancery Lane, W.C., to hear an account of the winding-up from the liquidator, Mr. B. B. McCallum.

Dissolutions of Partnership.—Premier Electrical Engineering Co., electrical engineers, 19, Bull Close Lane, Halifax.—Mr. C. Pollard and Elsie Ingham have dissolved partnership. E. Ingham will attend to debts, and continue the business under the same style.

Lead.—In their report, dated September 11th, Messrs. G. Cawson & Co. state :—

> The market this week has been unsettled, and prices have declined. There is, no doubt, plenty of available lead in warehouse. Holders, however, prefer to retain it, instead of going to the expense of re-housing parcels later on. Arrivals last month were very heavy, totalling nearly 15,000 tons, but they may be lighter the next few weeks, as the Broken Hill Co. have declared some delay in their shipments. Meanwhile, Germany still continues to send in lead to this country. Shipments from Spain are also coming in, and good arrivals are expected during the month. France now appears to be receiving all the lead she requires, and is apparently shipping any surplus to this country. The demand for export and home consumption is exceedingly quiet, and some of the electrical works are asking sellers to postpone deliveries of lead. The lock-out in the electrical shops continues, and at the moment there is no prospects of an early settlement. In fact, the dispute is now receiving the attention of other branches of the Electrical Trades Union, and, should they decide on a sympathetic strike, the present poor consumptive demand for lead would be further affected.

Messrs. James Forster & Co. say :—

> The Board of Trade Returns for August are :—Imports, 14,767 tons; exports, 5,107 tons; leaving 9,650 tons for home consumption.
>
> At the present time, with the exception of a few inquiries for prompt lead, the demand from consumers is on a very small scale, the existing labour troubles, combined with those that are threatening, naturally exercising a very depressing influence. With these difficulties out of the way and confidence restored, an active demand would soon be in evidence, with a corresponding rise in values, as the visible supplies and anticipated arrivals during the next few months certainly appear insufficient to meet an average consumption.

New Lamp Works in U.S.—The National Lamp Works of the General Electric Co., with main offices in New York, intend to erect two factories in Indianapolis for the manufacture of incandescent and automobile lamps, at an estimated cost of $2,000,000. The capacity of the plant is to be 160,000,000 lamps per annum.—*Reuter's Trade Service.*

Tenders for Hydro-Electric Plant for Argentina.—Hydraulic turbines, high-tension generators, switchboards, transformers, cables, and other equipment required for two large hydro-electric plants in course of construction on the River Maipo, Argentina, have been ordered in the United States. Vickers, Ltd., quoted £20,000 for the turbines, and £44,000 for the generators, with delivery in 15 months. Boving & Co., Ltd., of London, with the Swedish General Electric Co., quoted for Swedish-made turbines £19,425, delivery eight months, and for generators £33,600, delivery 17 months. The American Pelton Wheel Co. and Westinghouse Co. quoted $157,000 U.S. gold (say, £39,250) for the turbines and generators, delivery nine months.—*The Ironmonger.*

Trades Telephone Directory.—The directors of the Business Telephone Directories, Ltd., 25, Lawrence Lane, E.C., inform us that they have concluded an agreement with the Postmaster-General under which they have the sole right of publishing a Classified Trades Telephone Directory for London. This directory will be known as "The Buff Book," and will be published half-yearly in October and April. The classified Trades List of Subscribers at the end of the present Post Office Telephone Directory will be discontinued, but under the agreement with the Post Office, a copy of the new directory will be supplied to every telephone subscriber in the London area.

Book Notices.—*The Electricity (Supply) Act, 1919, with Notes.* By W. S. Kennedy, LL.B., Barrister-at-Law. London : The Electrical Review, Ltd. Price 3s. 6d. net, post free 3s. 8d.—Whenever the British Parliament passes an Act, the question immediately arises : What does it mean ? The Electricity Act of 1919 is no exception to the rule ; and as its provisions have a very direct bearing upon the daily affairs of a very large number of electrical engineers and others engaged in, or associated with, the electrical industry, this small handbook will be generally welcomed. Had the author waited until the postponed sections could be dealt with, his book might have been in time for the next generation—fortunately, he decided to carry on at once. The plan of the work is to give each clause *in extenso*, and to append shrewd explanatory comments, in which the author does not hesitate to travel far afield and to criticise the drafting of the clauses freely. Appendices give the form of notices issued by the Commissioners, a memorandum for the guidance of bodies desiring to submit schemes, draft rules with respect to applications for special orders, &c. The book will be especially useful to electricity supply authorities, both company and municipal, as well as to local authorities in general, manufacturers who have, or wish to have, their own generating plant, and others interested in the subject of the Act.

"Motor Cyclists' A.B.C." By H. Wyatt. London : George Newnes, Ltd. Price 2s. net.

"Income-Tax for Year 1920-21 : Rates, Relief, Repayment." London : Fred. C. Mathieson & Sons. 2s. net.—This is a 66-page pamphlet on a subject of great importance to most of us. There is a reprint of the Income-Tax Portion of the Finance Act, 1920, a list of stocks taxable by assessment, and a useful index.

"The Fireman's Handbook and Guide to Fuel Economy." By C. F. Wade. Pp. iv + 84 ; 29 illustrations. London : Longmans, Green & Co. Price 2s. 6d. net.

"The Motor Transport Year-Book." Vol. V. 1920. London : Electrical Press, Ltd. Price 20s. net.

The Overtime Question.—The Bradford branch of the Amalgamated Engineering Union held a meeting on September 12th, and re-affirmed their decision to maintain the ban on overtime ; speakers advocated a strike for the enforcement of the demand for an advance of 6d. on the present rate of 1s. 10½d. per hour. A strike in sympathy with the miners was also advocated, but neither of the proposals was embodied in a resolution.

A Good Day for St. Dunstans.—As the result of a Charity Bowling Match, Anchor Cable Works *v.* Leigh and District, played on a recent Saturday afternoon, St. Dunstans Hostel for Blinded Sailors and Soldiers has received a cheque for £106 18s. A similar match played two years ago realised £62 5s. 1d. On both occasions the expenses were defrayed by the firm, thus enabling the Anchor Athletic Club to remit the gross proceeds.

Foreign Trade.—August Figures.—The following are the values of imports and exports of electrical goods and machinery in August :—

	August, 1920.	*Inc. or dec.*	8 *months*, 1920 *Inc. or dec.*
	£	£	£
Imports.			
Electrical goods, &c. ...	147,844	+ 75,434	+ 45,724
Machinery	2,091,212	+ 960,767	+ 2,992,833
Exports.			
Electrical goods, &c. ...	888,030	+ 233,312	+ 3,757,542
Machinery	5,530,697	+2,460,779	+19,013,926
Re-exports.			
Electrical goods, &c. ...	12,688	+ 5,224	+ 13,930
Machinery	167,840	+ 62,648	+ 585,644

Catalogues Wanted.—Mr. E. C. Pratt, of Lannarth, Woodford Green, Essex, desires to receive catalogues of electrical goods, &c.

Fire.—An outbreak of fire, on Friday last, at the wholesale clothing works of Mr. George Crossland, Huddersfield, was attributed to the overheating of an electric iron, the appliance not having been disconnected when work ended for the day. The outbreak was quickly extinguished by the fire brigade.

Social Events.—E.S.A. GARDEN PARTY.—The annual garden party and sports meeting of the Elliott Social Association, in connection with Messrs. Elliott Brothers (London), Ltd., of Lewisham, was held on Colfe's Grammar School Ground at Eltham Green on Saturday, September 4th, when about 700 members and friends spent a very enjoyable time. The representatives of the company included Mr. W. O. Smith (president, E.S.A.), Sir Keith Elphinstone, K.B.E., and Messrs. L. W. and R. O. Smith, with their wives and friends. Lady Elphinstone opened the proceedings with a happy speech full of good wishes for all concerned, and was presented with a bouquet of pink carnations. The sports programme included running and walking races, inter-departmental tug-'o-war (ladies and gentlemen), pillow fights, slow cycle race, obstacle race, bandsmen's race, and many others, including children's races, in all 23 events. An invitation to Messrs. Siemens Bros., of Woolwich, resulted in their sending a tug-'o-war team to compete with Elliott's, and after a struggle the latter team won. Music was provided during the afternoon by the Lewisham National Reserve Band. Sweets, cigarettes, ices, fruit, and mineral waters were obtained throughout the afternoon at a stall in charge of some of the ladies from Century Works, and entertainments were provided, which included boat swings, cocoanut shies, houp-la, skittles, balloon smashing, roundabout, &c. Teas were provided in marquees. The prizes, which numbered 67, were given by the directors of Messrs. Elliott Brothers, and distributed by Mrs. R. O. Smith, who was presented with a bouquet of pink carnations. After the prize distribution dancing was in progress till 9 p.m.

YORKSHIRE POWER CO.'S STAFF OUTING.—The various staff engineers using motor cycles in connection with their work on the Yorkshire Electric Power Co. combined on Saturday, September 4th, a somewhat strenuous reliability trial with a social outing for their wives and friends. Fourteen competitors, each with a lady passenger in the side-car, started from Thornes Mill on the Denby Dale Road, Wakefield, and proceeded via Holmfirth, Dunford Bridge, and Glossop to the lunch stop at "Snake Inn." This portion of the route comprised a non-stop section in which any stoppages were penalised, and an "observed hill" for which marks were given on merit of performance, and a "secret check" for time keeping. The test for all speed was based on an average of 17 miles per hour for machines up to 4¼ H.P. and 19 miles per hour for machines over that figure. After lunch the competitors restarted for the second half of the run, via Sheffield and Wadsley Bridge to Cawthorne. This section included a test for "quick starting," a second observed hill, and an intermediate checking point for time. All the competitors completed the course, and the results of those leading were very close indeed.

Awards were given for the highest individual marks obtained, and resulted as follows:—

First Prize.—Plated muffin-dish, presented by Mr. W. B. Woodhouse, the company's engineer and manager, to Mr. W. Evers (P. and M.).
Second Prize.—Handle-bar watch, which was presented to Mr. A. W. Usher (P. and M.).
Third Prize.—Handle-bar mirror, which was presented to Mr. S. R. Siviour (P. and M.).
Fourth Prize.—Handle-bar muffs, presented to Mr. R. C. Hatton (B.S.A.)

The special prize of a Cowey mechanical horn was presented by Mr. F. J. Brown to the P. & M. machine with the least variation in time at the two intermediate checks, and it was also won by Mr. W. Evers. The "Team Prize" was carried off by the construction department with the highest aggregate of marks.

At Cawthorne other members of the staff met the party, and joined them at tea. The arrangements for the trial were in the hands of Mr. H. Fraser, chief marshal, assisted by Messrs. W. B. Woodhouse and P. Furness as judges, Mr. A. A. Field as time-keeper, and Messrs. G. Melton, F. J. Stevenson, E. S. Prior, and J. Asquith as observers. Mr. S. R. Siviour was the organising secretary. This is the second reliability trial which the company's motor cyclists have carried out, and it is hoped to make it an annual event for the future.

The New Zealand Electric Railway Contract.—H.M. Trade Commissioner at Wellington, New Zealand, has recently cabled to the Department of Overseas Trade the award of a contract to the English Electric Co., for the electrification of a section of the Midland Railway of New Zealand. He adds that special importance is attached to this contract as it was obtained on the merits of the tender in the face of strong American competition. We made brief reference to the matter in last week's ELECTRICAL REVIEW.

The section to be electrified is known as "Arthur's Pass." It is the connecting link between the Government railway system and the east coast and west coast of South Island. At present the whole of the railways in New Zealand are steam operated, and it is not proposed at present to electrify more than the section covered by this contract. The importance of awarding the first contract to a British firm will, therefore, be appreciated. The section to be electrified includes a tunnel over five miles long and three steel bridges, the rest of the section consisting of earthworks. A great portion of the section is on a grade of 1 to 33, and the summit is about 2,400 feet above the sea level. Considerable snow falls in some winters, as much as 5 ft. having been experienced. The contract includes the provision of the power plant, the tunnel lighting installation, the overhead transmission line, and the complete equipment for the electrical operation of the section of the railway referred to. The system to be used is 1,500 V., D.C., overhead contact. The power house must be at Otira Station, which is 1,260 ft. above sea level, and the power will be generated by geared turbine direct-current sets. The boilers, it is proposed, should be operated on dust fuel in order to utilise the product of a number of local coal mines at which coal is raised which is too fine for ordinary consumption.

A Proposal for a Canadian National Electric Code.—A Canadian correspondent writes: British exporters of electrical material to the Canadian market may be interested in the proposal which is now being made to technical bodies in the Dominion having in view the establishment of a Canadian National Electric Code, and suggesting the appointment of a small committee to make a preliminary report on the matter.

At the present time matters having regard to electrical inspection are in the hands of the fire insurance companies identified with the Canadian Underwriters' Association, American standards being in force, and all electric lighting material has to bear the label of the Chicago laboratory. The question is being canvassed whether, in the possible event of a Canadian code being drafted, it should be a copy of the American regulation, and also whether in such event it would still be necessary to have materials and fixtures tested by an American laboratory.

The proposal is supported by, among others, the Royal Architectural Institute of Canada.

It should not be forgotten, in this connection, that a British Testing Laboratory is in process of formation—but the Board of Trade has taken a hand in the matter, and consequently progress is slow.

Hydro-electric Power Works of the Tasmanian Government.—Messrs. Boving & Co., Ltd., London, inform us that at the beginning of this month they secured an order from the Tasmanian Government for a further two 8,000-B.H.P. water turbines, in connection with the extensions to their "Great Lake" hydro-electric power station. When these two machines are installed, there will be a total of nine, all of which will have been supplied by Messrs. Boving, and the station will then have been completed.

The main generating equipment installed or on order, consists of two 5,000-B.H.P. water turbines, coupled to generators supplied by the British Westinghouse Co., together with seven 8,000-B.H.P. water turbines coupled to generators supplied by the International General Electric Co., or a total of 66,000 B.H.P. in all.

The water turbines, which are of the single-wheel Pelton type, with two jets, work under a total net head of 1,015 ft., and it is especially interesting to note that the 8,000-B.H.P. extension sets—all of which are duplicates—are by far the largest Pelton wheels ever manufactured in this country. Messrs. Boving are to be congratulated on their demonstration that there is no need to go abroad for large water turbines.

An Inquiry from Bergen.—H.M. Consul at Bergen reports receipt of an application from a local firm who wish to be placed in touch with United Kingdom manufacturers of electrical machinery, dynamos, motors, electrical fittings and elevators. The firm have for some time represented two Swiss firms, but these having proved unsatisfactory in delivery and business methods, it is desired to open up new connections with British firms, with whom little or no business has been transacted in this class of goods.

The name and address of the Bergen firm referred to, with particulars as to their capital, &c., will be furnished by the Department of Overseas Trade to United Kingdom manufacturers interested on application.

Patent Extension.—A petition for the extension of the term of the Patent No. 15,599, of 1903, granted to Valdemar Poulsen, has been made by C. Hage, the British and Overseas Engineering Syndicate, Ltd., and the Poulsen Wireless Telegraph Co., Ltd., and will be heard on October 20th.

Manufacturing in Australia.—In the House of Representatives, Mr. Hughes (the Prime Minister) announced that the Federal Government proposed to offer inducements in order to encourage the manufacture of engines and aeroplanes in Australia. The Federal Government would not hesitate to offer a substantial bonus for this purpose.—*Reuter's Trade Service* (Melbourne).

New Spanish Electric Welding Company.—Under the title of Compania Soldadora Electrica de Espana, a new concern has been constituted at Bilbao, with a capital of 500,000 pesetas, for the purpose of exploiting a patent for the welding of metals by electricity.—*Reuter's Trade Service.*

New Belgian Electric Lamp Co.—A company has been formed at Brussels, with a capital of 2,000,000 fr., under the style of the Société Belge pour la Fabrication de Lampes Eléctriques C.E.B., for the manufacture of electric lamps. Its offices are at 4, Montagne du Parc.

Copper and Lead Prices.—MESSRS. F. SMITH & CO. report, September 14th:—Copper (Electrolytic) Bars, £118, £ increase; do. sheets, no change; do. wire, rods, £134, £1 increase; do. H.C. wire, 1s. 4½d., ½d. increase.

MESSRS. JAMES & SHAKESPEARE, report, September 15th:—Copper bars (best selected), sheets and rods, £168, £2 increase; English pig lead, £37, £1 decrease on last week's quotations.

The Engineering Dispute.—On Saturday last the electrical Trades Union gave notice that its members would be withdrawn from the electricity supply, tramway and railway undertakings on Saturday next (to-morrow) unless the lock-out notices were suspended. The employers, on the other hand, declared that they had no intention of suspending the notices or of submitting the matter to a court of inquiry.

The Court, as constituted by the Ministry of Labour, comprises the following members: Sir David Harrel (chairman), Mr. J. N. Bell, Col. J. M. Denny, Messrs. John Hodge, M.P., T. B. Johnston, Owen Parker, and W. F. Purdy. Mr. H. W. Meikle, of the Ministry of Labour, is the secretary.

The terms of reference are: "To inquire into the causes and circumstances of the dispute which has led to a strike of the members of the Electrical Trades Union employed at the establishment of Cammell Laird & Co., Ltd., Penistone, near Sheffield, and to a lock-out of the members of this union in the employment of firms members of the Engineering and National Employers' Federations, with special reference to the position of foremen as regards trade union membership in the engineering industry, and report thereon."

The court commenced sitting at St. Ermin's Hotel, Westminster, on Tuesday. It is compulsory on both parties to attend the inquiry and produce such witnesses and information as the Court may desire. There was a full attendance of the members of the Court. The Engineering and National Employers' Federations were represented by Sir Allan Smith, and the Electrical Trades Union by Mr. J. R. Rowan, the general secretary. Considerable progress was made in eliciting the facts which led up to, and were connected with, the strike of the members of the Electrical Trades Union employed at the establishment of Cammell, Laird & Co., Ltd., Penistone, on Friday, July 2nd. Nine witnesses were examined, including foremen, shop stewards, chief electrical engineer and manager. Although the proceedings were not open to the public generally, a large number of representatives of the Engineering and National Employers' Federations, as well as members of the Electrical Trades Union and other unions, was present. The Court sat again on Wednesday morning and examined witnesses; it adjourned at one o'clock to enable the E.T.U. executive to meet the London employers and was to meet again on Thursday morning.

The Engineering and National Employers' Federations have issued a statement of their case, to the following effect:—

"The question raised by the union involves the fundamental principle whether employers are entitled to appoint foremen, whether they belong to a union or not. The policy of the union is to secure that all those in a position of authority over members of the Union should be themselves members of a trade union and subject to the discipline of the union.

"In connection with the suggestion of the Minister of Labour, that the Federations should suspend the lock-out notices in view of the Court of Inquiry which is to be instituted, it is clear that if the Federations were to suspend the lock-out notices—which were issued only after many weeks of patient negotiations had failed to end the dispute—the Federations would have been involved in the admission of the principle that their responsibility in the management of industry must, in all cases of dispute, be subject to the report of an outside inquiry appointed by the Government. The conduct of industry in such circumstances is hopeless. The principle involved affects not only the electrical industry, but all other branches of industry. It is fundamental. It is a challenge of the employers' right to exercise their functions of management."

The Huddersfield branch of the Electrical Trades Union has published in the local newspapers what might be termed a "black list," comprising the names of all local employers who are members of the Engineering Employers' Federation. The list includes most of the local enginering firms of all classes.

The members of the E.T.U. who have been locked out in Birmingham (2,200) passed a resolution at a mass meeting on Friday last demanding that the Executive Council of the union should withdraw the whole of the members throughout the country. Mr. A. Beardmore, district secretary of the union, stated that if the Executive Council took the national step demanded, the number out of work would be doubled; blacklegging would be impossible, owing to the attitude taken up by the Electrical Power Engineers' Association.

The effect on Birmingham and Midland industry had not, up to the beginning of the week, been appreciable. In some instances work could not be commenced at so early an hour as usual, but apart from this, little difficulty was experienced.

A correspondent informs us that last week-end only a small number of men (under a hundred) were involved in the electrical lock-out at Liverpool, but it was feared that the trouble might extend.

It is estimated that there are altogether 20,000 workers in electricity undertakings, railways, and tramways in the London area. The Engineering and Shipbuilding Trades' Federation has advised its affiliated members to refrain from doing work hitherto undertaken by members of the Electrical Trades Union, or to work with non-union men, or with power supplied by non-union labour.

The Executive of the E.T.U. has notified the secretaries of hospitals that labour will be supplied free to maintain the supply of light and power, if they will arrange to install temporary generating sets on their premises.

The National Joint Industrial Council for Electrical Undertakings held a meeting on Wednesday afternoon to discuss the situation. There were present representatives of the Incorporated Municipal Electrical Association, the Incorporated Association of Electric Power Companies, the Conference of the Chief Officials of the London Electric Supply Companies, the Provincial Electric Supply Committee of the United Kingdom, the Electrical Trades Union, the Amalgamated Engineering Union, the Amalgamated Society of Gas, Municipal and General Workers, the National Amalgamated Union of Enginemen, Firemen, Mechanics, Motormen and Electrical Workers, the National Amalgamated Union of Labour, the National Union of General Workers, and the Workers' Union.

After a lengthy discussion the following resolution was adopted and was communicated to the Minister of Labour:—

"At a meeting of the National Joint Industrial Council for the Electricity Supply Industry held on September 15th, 1920, at the request of the Ministry of Labour, it was agreed that the Electrical Trades Union should be recommended to suspend their strike notices until after the Court of Inquiry has reported to the Ministry of Labour, and it was also agreed that the E.T.U., having intimated to this Council that they are prepared to withdraw the question of principle arising out of the Penistone dispute, this intimation be regarded as an acceptable basis of settlement, and it is, therefore, recommended that the Engineering Employers' Federation should withdraw their lockout notices and the Union instruct their members to resume work immediately."

The Trade Union Congress passed a resolution condemning the refusal of the employers to withdraw the lock-out notices.

At a meeting of representatives of seven unions connected with electrical generating stations, on September 9th, it was resolved to ask the executives to give seven days' notice to cease work if the Employers' Federations refused to withdraw their lock-out notices pending the result of the inquiry of the Ministry of Labour. The E.T.U. and the E.P.E.A. were represented at the meeting.

Electrical workers in the Port Talbot district on Friday last tendered twenty-four hours' notice to cease work as a protest against the Steel Smelters' Union accepting one of the electricians as a member of their union. If a settlement is not effected, it will throw 2,000 workpeople out of employment.

In a circular letter the general secretary of the Electrical Power Engineers' Association, Mr. W. A. Jones, has made a statement with regard to the policy of the Association. He states that this Association was founded by the staff men in the electricity supply industry to enable them to take advantage of the benefits which could be obtained by collective bargaining, and to further this object they registered as a trade union, and definitely took their place in the industry as an employés' organisation. In order to meet the needs of all grades of staff men, it was necessary to lay down in the constitution as a definite principle that they would always adopt constitutional methods in their dealings, and if extreme action was ever resorted to it would be only after every other method had been tried and had failed, and the members concerned had agreed by a very large majority that such action was the only other alternative available.

In the interests of the industry, it was not desirable that it should be involved in every dispute in every industry, and because they were not able to remain neutral when a strike was in operation they intended to use whatever influence they possessed to get disputes, which did not primarily affect the industry, settled peaceably before the industry was involved.

If, on account of one of the parties rejecting a peaceable method of settlement, or refusing to make use of the regularly constituted machinery for the purpose, the dispute spread to the electricity supply industry, then the responsibility must rest with the recalcitrant party, and the E.P.E.A. would act in a way calculated to promote a settlement by negotiation, and would throw its weight into the scales on the side of the party which consented. This was the guiding principle of the Association. The E.P.E.A. recognised that as a trade union it was not entitled to give a verdict on the merits of a particular dispute, nor did it desire to do so any more than it desired other unions to pronounce a verdict on the merits of its own disputes, but it had a right to apply this fundamental principle which aimed at encouraging the use of machinery instead of force wherever possible.

When the present dispute between the E.T.U. and the Engineering and National Employers' Federation threatened to reach a deadlock the Association urged the two parties to refer the matter to arbitration, and asked the Ministry of Labour to intervene and prevent it spreading. The Minister of Labour offered to set up a court of investigation, and the E.T.U. agreed to accept it, but the employers' side refused.

The Association could not be a judge of the merits of the original trouble, that was a matter for the court of investigation; but it was concerned by the refusal of one of the parties to accept a just and constitutional method of settlement, and by its refusal involving another industry which ultimately might affect millions of people.

The Fulham Borough Council convened a conference of all the local authorities in Greater London owning electricity undertakings for the 16th inst. at the Fulham Town Hall to meet the Executive Council of the E.T.U.

LIGHTING AND POWER NOTES.

Accrington. — New Station. — At a meeting of the Accrington Electricity Committee a communication was read from the Electricity Commissioners referring to the application of the National Electric Supply Co. for permission to construct a generating station on the south bank of the River Ribble. The Commission desired to learn whether the Corporation wished to submit any observations as to the site of the proposed station. It was resolved that the Commission should be informed that the Corporation wished to protest against the proposal to erect the station in question, in so far as any future proposal or order might throw any financial burden or responsibility upon the borough or its electricity undertaking.—*Northern Daily Telegraph.*

Aldershot. — Bulk Supply. — The War Office has informed the Urban District Council that it cannot accede to the request to supply electricity in bulk from the Camp station. This means an expenditure of £21,000 on new plant, &c., but the Council is approaching the Commissioners with the object of bringing pressure on the War Office to give the supply asked for.

Bedford. — Strike Averted. — The Electricity and Public Lighting Committee, having agreed to recommend the Council to ante-date payment of bonus to the power station staff to January 1st, the notice of withdrawal, to take effect on September 10th, was not acted upon.

Blackpool.—Loans.—The Town Council has decided to apply for sanction to borrow £4,250, for the doubling of a length of tramway track in New Road, and £30,000 for new mains, distributors, transformers, and other services required in the electricity undertaking.

Bradford.—Wages Settlement.—All engineers in the employ of the Corporation have had their wages increased up to a minimum of 2s. per hour, and retrospective to March 29th. The Industrial Council's award with reference to employés in the electricity and tramways departments has also been accepted by the War Wages Committee.

Burnley.—Extensions.—The Council has sanctioned the placing of a contract for extensions with the English Electric Co., Ltd., for £107,400, but the question of what will happen respecting future development will depend upon what proposals the district authority can agree to for effecting an improvement in the organisation of the supply of electricity throughout the district. The Electricity Commissioners propose to hold an inquiry some time after September 30th to receive a scheme for electricity supply in the Mid-Lancashire district, and at the present time the District Committee is busily engaged preparing the scheme. Applications from large power users have again been refused owing to the limited capacity of the existing plant. The department will be put to a severe strain during the coming winter to maintain continuity of supply during peak loads.

Cheriton. — Public Lighting. — The Urban District Council has asked the Folkestone Electricity Co. for an estimate for lighting the town by electricity in place of gas.

Colchester.—Strike Averted.—The staff of the Corporation electricity works threatened a stoppage of work on Tuesday, September 14th, if their demands for the £30 bonus were not acceded to. Ultimately the men agreed to negotiate on the question, and the threatened strike was abandoned.

Dover.—Loan Sanctioned.—The Town Council has received sanction to a loan of £20,067 for new plant.

Dublin.— Reduction of Expenditure.—To meet the position arising on the Government's decision to withhold over £200,000 in grants, the Corporation, last week, decided to reduce expenditure and defer payment of 25 per cent. wages and salaries. As applying to public lighting the saving in the current year's expenditure under the order will be £15,000.

Dundee. — Tummel Valley Scheme. — The *Dundee Courier* reports that efforts are being made to float a company to carry out the Tummel Valley electricity project. It will be remembered that the Dundee Corporation had to abandon the idea, owing principally to the large amount of capital expenditure involved, about £1,000,000. A proposal that an electricity authority comprising representatives of Dundee, Perth, Forfar, Arbroath, and other authorities should be formed to deal with the matter, has been in abeyance for some time. Already a sum of £50,000 has been subscribed for the purpose of promoting a Parliamentary Bill authorising the work. The capital of the company, it is stated, will be £3,000,000.

Edinburgh.—New Station.—At the new station at Portobello the steel construction work for the turbine house is now complete, and awaits the superstructure. In this building will be installed three 10,000-kw. turbo-generators and switchgear. While the initial capacity will be 30,000 kw., there will be room for development to 100,000 kw. The boiler house will be situated to the north of the turbine house. The first set of turbo-generators will be ready at the end of December, and the last by the end of February, and the Committee is hurrying on the building so as to be able to house them. On the seaward portion of the site operations are proceeding for the construction of three tunnels for the conveyance of the water for the condensers, and considerable progress has been made with this work.

Hatfield.—Offer of Supply.—The North Metropolitan Electric Power Supply Co. is about to lay mains from Hertford to St. Albans *via* Hatfield, and offers to supply the town if local support warrants it doing so.

India.—Karachi Power Station.—The *Indian Textile Journal* states that the capital for doubling the generating capacity of the Karachi Electric Supply Corporation's plant has been nearly three times over-subscribed. The station is equipped with Diesel engines, the plant comprising one 100, two 240, and one 320-b.h.p. engines, all built by Messrs. Mirrlees, Bickerton & Day, Ltd. It is stated that the plant is to be augmented by three further units of 320 b.h.p.

New Hydro-electric Project.—Further information regarding the Nilgiris electricity scheme shows that the conditions as to the concession agreement, as well as the licence from the Government, are practically settled with Messrs. Tata Sons, Ltd. The project, as far as the hydro and generating plant are concerned, is completely planned, and the transmission lines and receiving station have been designed. A tract of land has been purchased on the north boundary of Coimbatore city as the site for a receiving station and for new industries which may be developed and become consumers of electric energy. The project is capable of developing up to 20,000 h.p. for delivery to consumers. At the outset the generating station will be equipped for the supply of 7,500 h.p. That represents the initial stage. The receiving station for Ooty will be at Charing Cross, where the pressure will be reduced from 60,000 to 3,000 volts.—*Indian Textile Journal.*

Sivasamudram Undertaking.—The latest report of Mr. S. G. Forbes, chief electrical engineer to the Mysore State, shows that the total quantity of power generated at Sivasamudram in 1918-19 was 102,530,000 units, an increase of 4,442,100 units. The cost of generation, including proportionate interest, depreciation, and administration charges on the capital cost of plant, buildings, &c., was '0777 anna per unit. Adding '0122 anna to the above on account of the allowance for margin of safety, the total cost of generation per unit was '09 anna per unit. The total capital of the Cauvery power scheme up to the end of 1918-19 was Rs. 1,20,38,443. The net profits of the scheme, less depreciation fund and interest at 4 per cent. on the capital outlay, were Rs. 1,50,15,549.—*Indian Textile Journal.*

Knaresborough. — Lighting Economy. — As a precautionary measure against the threatened coal strike, it has been decided that only part of the town shall be lighted at night for the present, and that the full lighting shall not be resumed till a settlement of the dispute is reached.

Water-power Scheme.—Negotiations are proceeding between the Urban District Council and Messrs. Vickers, Ltd., with regard to the possibility and cost of a scheme for utilising the water power of the Nidd at the weir for supplying the town with electricity. The Council has not definitely embarked on a scheme, but is inquiring principally as to the cost of the project. An expert suggests the provision of "flash-boards" 1 ft. deep on the crest of the weir, which would give a 10 per cent. increase of power, but would probably put the boating landing stage under a few inches of water. The most economic position for housing the plant is the turbine house at the linen mill of Messrs. Carson, and the Council has decided to approach the firm on the matter.—*Yorkshire Observer.*

Leith.—Year's Working.—As a result of the working of the Corporation electricity department for the year ended May 31st, the previous year's deficit was paid off, and a net balance of £6,174 remained.

London.—Lighting Economy.—In order to conserve the present coal stocks as far as lies in their power, many of the largest London firms have given instructions for their electrically-illuminated signs to be switched off until further notice. As the signs are numerous and of large dimensions, a great economy will be effected by this means.

Fulham.—The Borough Council has received sanction from the Electricity Commissioners to the borrowing of £5,577, the cost of "linking up" with the Hammersmith undertaking, and £5,593 for mains and transformers for other purposes.

Lurgan.—Loans.—The Council has decided to apply to the Local Government Board for sanction to several loans, including £25,000 for an electric lighting scheme, and £4,000 for conversion of power at Castor Bay from steam to electricity.

North-West Midlands Electricity District.—Notice is given that the Electricity Commissioners have provisionally determined that the undermentioned area shall be constituted a separate electricity district for the purposes of the Electricity (Supply) Act, 1919, that is to say:—

So much of the County of Chester as is included in the Municipal Boroughs of Congleton and Macclesfield; the Urban Districts of Alsager, Bollington, Buglawton, Sandbach, and Yeardsley-cum-Whaley; and the Rural Districts of Congleton, Disley, and Macclesfield.

So much of the County of Derby as is included in the Urban District of New Mills; the Rural District of Hayfield.

So much of the County of Salop as is included in the Municipal Boroughs of Bridgnorth, Shrewsbury, and Wenlock; the Urban Districts of Church Stretton, Dawley, Market Drayton, Newport, Oakengates, and Wellington; the Rural Districts of Atcham, Bridgnorth, Chirbury, Church Stretton, Drayton, Newport (Salop), Shifnal, and Wellington; the Parishes of Lydham, Mindtown, More, Norbury, Ratlinghope, Shelve, and Westnor, in the Rural District of Clun.

So much of the County of Stafford as is included in the County Boroughs of Stoke-on-Trent, Walsall, West Bromwich, and Wolverhampton; the Municipal Boroughs of Lichfield, Newcastle-under-Lyme, Stafford, Tamworth, and Wednesbury; the Urban Districts of Ambleoote, Audley, Biddulph, Bilston, Brierley Hill, Brownhills, Cannock, Coseley, Darlaston, Kidsgrove, Leek, Perry Bar, Quarry Bank, Rugeley, Sedgley, Short Heath, Smallthorne, Stone, Tettenhall, Tipton, Uttoxeter, Wednesfield, Wednesfield Heath, otherwise Heath Town, Willenhall, and Wolstanton United; the Rural Districts of Blore Heath, Cannock, Cheadle, Dudley, Gnosall, Kingswinford, Leek, Lichfield, Mayfield, Newcastle-under-Lyme, Seisdon, Stafford, Stoke-on-Trent, Stone, Tamworth, Uttoxeter, and Walsall and those parts of the Rural District of Tutbury known as Tutbury Rural District detached No. 1, and Tutbury Rural District detached No. 3; and the Parishes of Blymhill and Weston-under-Lizard.

Objections and representations may be made in writing to the Secretary, Electricity Commission, Gwydyr House, Whitehall, London, S.W. 1, not later than January 31st, 1921. Notice will be given of the date on which the local inquiry into the existing organisation for the supply of electricity in the district outlined above, is to be held.

Oldham.—Cooling Towers.—The Electricity Committee proposes to erect additional water-cooling towers at the Greenhill generating station.

Oswestry.—Overhead Mains.—The Town Council at a recent meeting adopted the recommendation of the General Purposes Committee to refuse permission to the Oswestry Light and Power Co. to erect overhead lines.

Peterborough.—Position of Undertaking.—At the last meeting of the City Council, on September 10th, Sir R. Winfrey directed attention to the serious position of the electricity undertaking as revealed by the accounts for the previous month. He noticed that in July there was an increase in the units sold of 4,007 over the corresponding period in 1919, but electricity was costing the Council two and a-half times as much this year as it did two years ago. Discussing the reasons, he pointed out that it now took 11¼ lb. of coal to produce a unit of electricity, whereas last year it occasioned a consumption of 8¼ lb. only, and in 1918, 7 lb. The result was that whereas last year in July there was a surplus profit, without reckoning the amount for interest and repayment of loans, of £290, this year there had been a loss of £319, making a difference of over £600. If that went on month by month it would work out at a loss for the year of £9,300.

Plymouth.—Electric Cooking.—At a meeting of the Corporation Electricity Committee, a letter was read from the secretary of the Electrical Trades Union suggesting that cooking by electricity be adopted in all the cookery centres, and that, prior to any school being renovated, electricity be installed for heating and illuminating. It was agreed to inform the Union that the Committee will give careful consideration to this matter when opportunity arises.

Sabden.—Water-power Scheme.—At a Parish Council meeting, on September 9th, the question of the production of electricity by water power for illumination and other purposes was discussed. The chairman said several places in the North were now economically and effectively illuminated by electricity produced in this way, and a local deputation had visited one such installation and had reported very favourably. Sabden had natural advantages in water supply. It was decided to obtain expert opinion on the subject.

Stafford.—Agreement with Company.—The Town Council has completed negotiations and approved of an agreement with Messrs. W. H. Dorman & Co., Ltd., for the supply of electricity to the company's factory in Foregate Street, Stafford, and to the proposed new factory at Littleworth. The agreement, which is for a term of seven years from March 1st, 1921, provides that during its continuance the company is not to take power from any other person nor to put down a power house of its own (save in exceptional circumstances), the company to loan the Corporation such a sum not exceeding £5,000 as may be required for the laying of a high-tension cable to the company's factory at Littleworth, this sum to be repaid to the company by way of a rebate of 20 per cent. on the amount of the annual accounts.

Stratford-on-Avon.—Proposed Municipalisation.—The Electricity Co. has offered to sell the undertaking to the Corporation for £10,000, and the matter has been referred to the Electricity Committee for consideration. Two previous offers have been made to the Town Council to acquire the undertaking—first for £20,000 and later for £13,000 or £14,000.

Sunderland.—Extension of Services.—The Town Council is making application to the Electricity Commissioners for sanction to expend an additional sum of £6,000 upon consumers' services.

Thirsk.—Public Lighting.—The Sowerby (near Thirsk) Council has accepted the offer of the Northern Counties Electric Supply Co. to supply electricity, including maintenance, but not lighting and extinguishing, for street lamps during the winter, at 46s. per lamp. The company stated that it was introducing a new system of supply in the town, and in the meantime the Council would be required to accept responsibility for any accidents arising from the present standards. The Council accepted the responsibility.

U.S.A.—Texas.—Capitalists interested in the Syndicate Power Co., recently organised with a capitalisation of $20,000,000, are endeavouring to complete arrangements to finance their enterprise this year and begin actual construction during the winter on hydro-electric plants that will generate a total of 48,000 kw. One dam is under construction, and there are four other dam sites available on the Colorado river near Marble Falls, Texas, where the first water-power electrical installation will be placed. Well-known engineers have estimated the cost of the plants now in view at $12,000,000.—*Reuter's Trade Service* (San Francisco).

Wallsall.—Year's Working.—There was a net profit on the working of the electricity undertaking last year of £10,523.

Extensions.—The Town Council is to ask the Electricity Commissioners for sanction to complete the Birchills station at an estimated cost of £119,000. When the Commissioners were approached on the subject some time ago, they asked the Council to endeavour to obtain a bulk supply from a neighbouring authority. The terms proposed by Wolverhampton were so disadvantageous that the matter was not proceeded with; Walsall would have borne all the cost for the provision of a bulk supply, and the price suggested was double the cost of production.

West Hartlepool.—Year's Working.—The accounts of the electricity undertaking show a net balance for the past year of £1,358.

Winchester.—Reserve Fund.—A proposal to transfer a sum of £2,000 from the electricity department reserve fund, which at present stands at £6,629, to the Finance Committee for rate aid, was defeated at a recent Council meeting.

Worcester.—Staff Salaries.—At a meeting of the City Council on Tuesday last week, the High Sheriff (Mr. W. J. Hill), who is chairman of the Electricity Committee, reminded the Council that at a former meeting he had stated that the Committee was not prepared to recommend the Council to adopt the scale of pay suggested by the Joint Board relating to technical officials in the electrical industry. At the time when the demands were put before the Committee, the alternative suggested was a strike. The position had now altered. A large number of electricity undertakings throughout the country had adopted the scale, which was considerably higher than the rates the Committee was paying, and not only could the Committee not get satisfactory engineers to fill the vacancies which already existed, but practically the whole of the technical staff was leaving. Mr. R. Smith, the chief assistant, had resigned; the senior shift engineer had obtained another position; the station superintendent had asked for a testimonial, and two shift engineers had done likewise. The Committee could not carry on the station without an adequate staff of men who understood their profession; and it must be quite clear to the Council that it could not get that adequate staff unless it was prepared to pay at least as much as other undertakings were paying. There was a serious risk that within the next few weeks the Committee would be without electrical engineers altogether, and in view of the urgency of the matter he asked the Council to authorise the Committee to do what it might consider necessary to secure that the undertaking was efficiently equipped with technical staff. He had not the slightest doubt that it would involve paying the scale referred to. He thought a substantial saving could be effected by reorganisation of the technical staff. The electrical engineer (Mr. C. M. Shaw) had resigned his position as development officer, and one or two positions on technical committees, and was prepared to devote the whole of his time to assisting the Committee to overcome the present difficulty. Substantial increases in the salaries of the officials and of Mr. Shaw, would be necessary. The Chairman's motion giving power to the Committee was agreed to.

TRAMWAY AND RAILWAY NOTES.

Aberdeen.—Year's Working.—The analysis of receipts and expenses of the City Tramways Department for the year ended May 31st, 1920, records a total income of £169,731, as compared with £140,901 for 1918-19. Working expenses amounted to £141,852, as against £108,451, leaving a gross profit of £27,819 (£32,450). The payment of loan interest, depreciation charges, &c., resulted in a net loss of £5,208. Last year's result was a profit of £6,837. The depreciation and renewal fund now stands at £217,458. The total number of passengers carried during the period covered by the report was 48,544,709.

Bradford.—Track Renewal.—The tramways track between Tong Cemetery and the Birkenshaw terminus, on the Wakefield Road section, is to be renewed at an estimated cost of £21,480.

Fare Increase.—The increase in the tramway fares has again been considered, and the special sub-committee has decided to recommend that from October 1st all ordinary tramway tickets (except 6d. tickets) shall have one halfpenny added to them, with a minimum fare of 2d.: children from 5 to 14 years of age, half-price; and scholars attending a day school, 1d. to and from school. No change is made in workmen's fares at present, but parcel rates are to be increased.

Brighton.—Wages Settlement—Erratum. — Owing to a misunderstanding, it was stated in these notes, in our last issue, that the Corporation had decided to accede to the tramway employés request and pay them Grade 1 rates. This was merely a recommendation of the majority of a committee appointed to deal with the question. The report, however, was rejected at the Corporation's meeting on September 9th, and it was resolved to keep the Grade 2 rates in force.

Camborne.—Fares.—The local Labour and Trades Council has forwarded letters to the Ministry of Transport and the Urban Electric Supply Co., protesting against the company's application for power to increase its fares by 100 per cent. It is stated that no specific provision is made for workmen's fares in the district, which is one of the worst paid in the country; also, that the Camborne system is already being run at a profit owing to a previous increase of 50 per cent., and that, therefore, the profit from the Camborne-Redruth system is being used to subsidise the company's other systems.

Chile.—Company's Offer.—In an interview with Reuter's trade representative, an official of the Chilian Electric Tramways stated that the company has offered to invest £3,000,000 in improvements of the tramway and lighting services on condition that the existing contract should be revised. The Government is considering the offer.—*Reuter's Trade Service* (Santiago).

Colombia.—New Tramway.—The town of Medellin is to build an electric street railway 15 miles long. Specifications have not yet been issued. Inquiries should be addressed to the Senor Ingeniero en Jefe, Medellin, Colombia, South America.—*Reuter's Trade Service* (Medellin).

Continental.—Belgium.—The electrification of the railways of Belgium is to be carried out in three stages. The first will include the conversion of the lines and stations connecting Brussels with Antwerp; the second will deal with the Luxemburg lines; the third with lines running out of Brussels not included in the first stage. On the Brussels-Antwerp line, passenger traffic will receive first attention, by trains equipped with four 275-h.p. motors. The re-erection of the Malines station, and the restoration of the Schaerbeek-Hal line are indispensable before a normal service is re-established. Branch lines from the Brussels-Antwerp trunk line will then be taken in hand. The Brussels Midi junction line will be converted as soon as it is finished. The double line joining Malines-Antwerp-Sud, as well as the Antwerp circular line, will also be electrified. The stations in course of rebuilding—Schaerbeek, Schaerbeek (Josaphat), Muysen, Zurenborg, Aastruwel, Kiel, Antwerp-Sud, &c., will be electrified so far as regards the arrival and departure platforms, but steam locomotives will continue to be used for other work. The whole of the lines electrified will be fed from three sub-stations, located at Schaerbeek, Malines, and Berghem.

Durham Co.—New Services.—On the instructions of the County Council, a Special Committee, with experts, is considering the feasability of introducing a 'bus and tramcar service, including the laying of a track from Durham to Gateshead.

Glasgow.—New Cars.—In consequence of the serious decrease in traffic since the imposition of higher fares, the Corporation has decided not to proceed with the construction of new cars for the present.

Leeds.—Parcels Traffic.—The carrying of parcels on the tramcars, started as a war-time project, has grown into a huge and profitable undertaking. At the present time about 4,500 parcels or packages are handled every week. About 300 firms have contracts for the carrying of parcels. They buy the stamps in advance, and receive a discount of 5 per cent. and 7½ per cent., according to the stamp values. Since the start in April, 1918, the number of parcels carried aggregates 263,789.

London.—Increased Fares.—On September 26th a scale of increased fares will come into force on the London Underground systems. This has not yet been published, but the companies concerned have obtained powers to charge a maximum rate of 1½d. per mile, with a minimum of 2d. for a journey.

New L. & S.W.R. Rolling-Stock.—In order to cope with the congestion on its electrified suburban lines during the busy hours of the day, the London and South-Western Railway has put into service a number of new "trailer" cars, thereby adding considerably to the carrying capacity of each train. Generally, each unit of an electric train on this line is composed of three carriages, two of them being motor coaches separated by a trailer or non-motor coach. There is a driver's compartment at each end of the unit, from which all the motors in the unit are controlled. During the busy hours each train is generally composed of two units, with the two trailer coaches added on the Waterloo to Waterloo *via* Kingston service. With the control on the multiple unit system every motor in each unit is controlled from the driving end. In order to increase the capacity of each train, while not going to the expense of new motors and control gear such as would be required in the construction of a complete unit, the length of each two-unit train has been increased by including two additional trailer coaches in the middle of the train. The new trailers are of the usual bogie type, similar to those already in use on the electrified lines, except that they are close coupled together in pairs, and at each end of the pair there are spring buffers similar to those on the motor coaches, and the control cables are carried along under the roof of the carriage, instead of under the floor. Connection with the motor coach is made in the usual type of plug-box at each end, and the cables are run to the top of the carriage, and looped at the other end across the close coupling, so that the multiple unit control is obtained as hitherto. The trailers are not provided with a driver's compartment or any form of control gear.

Manchester.—Stage Reduction.—The City Council has reduced the 1d. stage on the tramways from one-and-a-half to one-and-a-quarter miles. For two years the tramways have been losing £4,000 weekly.—*The Times.*

Preston.—Year's Working.—The statement of accounts for the year ended March 31st last shows a total revenue of £89,301, as against £77,930 in the previous period. Working expenses amounted to £65,931, against £52,877, leaving a gross profit of £23,370 (£25,053). The payment of capital charges left a net profit of £5,924. The total of the reserve funds now stands at £55,854.

St. Annes.—Tramway Purchase.—Some particulars of the purchase of the tramway undertaking from the Blackpool, St. Annes, and Lytham Tramways Co. were given by the chairman of the Committee at a meeting of the Urban District Council. On October 31st the Urban District Council will complete the purchase of the line for £135,000, plus £5,000 as compensation to officials. The Urban District Council is now entitled to charge 1½d., instead of 1d., but it is proposed to alter the stages; 25 per cent. of the net profit made in the Lytham area is to be paid to Lytham, which retains the right of future purchase. The company will work the cars for the Council at an agreed rate of interest, and a percentage of profit. The chairman stated that they had expert opinion that the tramway was in good order, that the Council had made a good bargain—a much more advantageous one than if it had waited till 1921—and that the venture should turn out successful.

Sale.—Railway Electrification.—The Urban District Council has been notified by the Manchester, South Junction, and Altrincham Railway Joint Committee that electrification cannot be undertaken owing to the prohibitive cost. A conference of local authorities is to be called to further consider the matter.

U.S.A.—New York Traffic Strike.—The strike of underground, surface, and elevated electric-car conductors has ended, so far as the company is concerned, and employés who have ignored the invitation to return to work will be reinstated only on a basis as new employés, forfeiting all rights of seniority and higher pay. The men, who struck without authority of the Unions, were nevertheless supported by the Union leaders once they were out, and the company, which refused to deal with them on the ground that they were irresponsible and unfaithful to their contracts, has the public support. The railway officials announce their intention to build up an entirely new force, using a small band of faithful employés as the nucleus, and they are confident that a weekly wage of from £6 to £8 will attract new men. The action of the transit company is significant, because this is the first time for some years that any corporation has decided that it is possible to reject utterly the strikers' demands or to hold them strictly to the terms of their contracts.—*Daily Telegraph.*

Walsall.—Year's Working.—A net profit of £979, and a loss of £1,613, were the results of the working of the tramways and motor-'bus service respectively, during the past year.

TELEGRAPH AND TELEPHONE NOTES.

China.—New Wireless Station.—The Government wireless station at the Temple of Heaven, Peking, is open for service, and all telegraph offices in the city accept wireless telegrams at the same rates as those charged for land-line messages for transmission to Kalgan, Wuchang, Woosung, Shanghai, and Foochow. Special rates apply to wireless telegrams sent to ship and aviation stations, and such messages are accepted only by the central office. This service, says the *T. & T. Age*, gives Peking improved communication with some of the most important commercial centres in China. It is reported that a wireless station will be established at Urga, Mongolia, during the present year.

France.—Wireless Telegraphy.—Two wireless connections have been set up by the French Administration of Posts and Telegraphs with, respectively, Hungary, and Jugo-Slavia. The fees are the same as those for telegrams forwarded by the ordinary means, but the dispatches should bear the words "Untaxed. Wireless" (non-taxée: voie T.S.F.). Should the wireless service be congested or interrupted, dispatches will be forwarded by the ordinary telegraph lines.

Hanover.—French Company Claims German Wireless Station.—The German Ministry of Posts has been informed that the French Compagnie Générale de Télégraphie sans Fil claims the German wireless station at Eilvese, in Hanover, as its property, on the ground that the Hochfrequenz Maschinen Co., of Berlin, in 1912 sold Prof. Goldschmidt's foreign patents to a French group, and in addition, ceded it the right to take over the Eilvese station by December 31st, 1914. Owing to the war the French company was unable to exercise this right by the date named, but relying on Article 299 B of the Peace Treaty, the French Government has informed the German Government that the agreement in question has again come into force. The position is considered in German

official circles to be very awkward because the Eilvese station is now included in the State telegraph system. The whole matter is to be considered by the Cabinet, which hopes, by negotiations, to avert the danger of foreign control of wireless telegraphy in Germany. Herr Bredow, Chief of the German Government Wireless Department, informed a representative of the *Lokalanzeiger* that the right possessed by the French company to take over the station did not include the right to operate it, because, by German law, no owner of a telegraph station has the right to use it without the Government's sanction. He expected the French company would try to settle the matter by surrendering the station to Germany in return for heavy compensation.—*Reuter's Trade Service* (Berlin).

London.—Automatic Telephone Exchanges.—That the decision to install in London a trial automatic exchange of the Western Electric "Panel" type may mark the commencement of a new era in telephone exchange design is the opinion expressed in a leading article in the *T. and T. Journal*. It goes on to point out that comparatively extensive experiments with automatic exchanges have already been made in the country; but the adoption of automatic switching for very large areas has presented considerable difficulties in connection with the provision of intercommunication between automatic and manual exchanges, the numbering of subscribers' lines and the routing of junction calls. One problem was to find a machine switching system which would be sufficiently flexible to permit the substitution to be effected without sacrificing the power, which a human operator possesses, of routing traffic to any exchange in whatever way the Administration may from time to time direct, without varying the manner in which a call to that exchange is passed by the public. In the mechanical switching system now to be tried in London the "panel" is an extensive *flat* multiple field over which the selector switches operate vertically. This characteristic at once differentiates the system from others of the automatic type in use in this country and is so outstanding as fully to justify the name "Panel System." A more remarkable feature, however, is the "sender," which acts as the agent of the human brain in setting up connections. It receives the number signalled by a subscriber and translates the signals into such others as the Administration may require for the purpose of routing the call satisfactorily and economically over the junction system. It varies the circuit conditions and determines what impulses shall be sent over the junction circuits for the purpose of meeting the requirements of the apparatus at a junction centre or a terminal exchange. The experiment should prove whether the system will be able to meet all the requirements of the inevitably long period during which manual exchanges must be retained. "We stand on the threshold of a new era, and it behoves the traffic and engineering officers of the British Post Office to gird their loins and to go forward with a strong heart and the will to establish the new order of things on a sure foundation."

The Times states that it is not expected that the necessary equipment from the U.S.A. will be available before next spring, and further time must elapse before the installation of the exchange will be complete.

New Zealand.—Wireless Time Service.—A wireless time service from the standard mean time at Hector Observatory, Wellington, was inaugurated a few weeks ago. Hitherto ships have been able to obtain such information only by request when off the New Zealand coast, but under the new system the time will be transmitted every Tuesday and Friday evening at 8.30 p.m.

Automatic Telephones.—The new automatic telephone system was expected to be in full operation in Hamilton by the end of August. The installation of batteries is complete, and the telephones have arrived. The new system provides for 1,100 lines, exclusive of out-district connections, which will still be worked on the manual system. As the town area already has well over 1,000 subscribers, additions will soon have to be made to the new plant to provide for future expansion.

As in most British countries, the telegraph and telephone engineer has had to work under the control of a postal official. This system has now been abandoned entirely in New Zealand, and the entire technical organisation of the services, including the management of telegraph and telephone offices, has been placed under the control of the chief telegraph engineer, who will be responsible only to the Minister direct.

United States.—New Tandem Telephone Board.—On April 17th, 1920, the first mechanical switchboard in Greater New York was put into service. According to the *T. and T. Age*, it is the first mechanical tandem board of its kind, not only in the New York Telephone Co.'s territory, but in the world. The "Metropolitan Tandem Board," as it is called, handles traffic heretofore taken care of by the Jersey, Long Island, and Westchester toll tandem board, calls being passed to the Metropolitan board, and trunks assigned in the same manner as at the other tandem boards. Connections with called offices and numbers are then established, by means of mechanical switching devices, with the called number direct at semi-mechanical offices, or by displaying the number on a call indicator at the manual offices. Ultimately calls between machine-switching offices will be handed through this office. Traffic is being routed through the new board gradually. After the final step has been completed, 80 central offices will be able to reach 64 other exchanges, requiring approximately 1,000 incoming and 1,000 outgoing trunks, the total daily traffic amounting to about 125,000 calls. In November, 1919, the training of operators was started with a short course at cordless "B" positions in a New Jersey semi-mechanical office, following which actual training was given by means of a dummy mechanical position. When the first groups of positions were turned over by the Western Electric Co., preliminary training was continued at the new positions. By means of specially-equipped test-boxes, calls were passed to the regular tandem positions, the tandem operator then proceeding to establish the connection, and causing a display at the originating test-box, by which means each test call was checked.

International Communications Conference.—The U.S. State Department announces that representatives of Great Britain, France, Japan, Italy, and the United States will gather at Washington, on October 8th, to prepare the agenda for the forthcoming International Communications Conference, at which the whole field of electrical communication between nations, as well as the question of what shall be done with the German cables, will be discussed. The United States will be represented at the meeting by Mr. A. S. Burleson (the Postmaster-General), Admiral Benson (the chairman of the United Shipping Board), and Mr. Walter Rogers (a Government wireless official).—*Reuter's Trade Service* (Washington).

Sweden.—Private Wireless Telephone.—The Government has granted Uddeholms Aktiebolag permission to establish a private wireless telephone connection with its branch office at Skoghall. This is the first private establishment of its kind in Sweden.—*Reuter's Trade Service* (Stockholm).

Wireless Clubs.—The *Wireless World* states that there are 41 clubs in the United Kingdom formed for the purpose of studying and practising wireless telegraphy and telephony. Of this number 20 clubs are affiliated with the Wireless Society of London. The total number of amateur club members in the United Kingdom is approximately 1,500, but this figure is short of the actual total.

Wireless Telephony.—In recent experiments by Marconi's Wireless Telegraph Co., Ltd., to determine the minimum power required to transmit wireless telephonic messages across the Atlantic, it is reported that perfectly audible speech was transmitted between Ballybunion, Ireland, and Newfoundland, with no more power than that developed by a portable Army set, which is driven by a 3½-h.p. motor-cycle engine.

CONTRACTS OPEN AND CLOSED.

(The date given in parenthesis at the end of the paragraph indicates the issue of the Electrical Review, *in which the "Official Notice" appeared.)*

OPEN.

Australia. — Commonwealth Government. November 24th. Protected cable terminals and cable distribution boxes.

Brisbane.—December 9th. Department of Public Works. Seventy three-phase oil-cooled core type static transformers.

Brisbane.—January 20th, and February 25th, 1921. The City Electric Light Co. 10,000-kw. turbo-alternator set; transformers and switchgear.

Melbourne.—September 23rd. Melbourne and Metropolitan Tramways Board. Two 350-h.p., a.c. motors, also switchgear. (Contract No. 101.)

February 24th, 1921. The Victorian Electricity Commissioners. Turbo-alternators of 25,000, 12,500 and 600 kw., and other plant connection with the Morwell power scheme.

Queensland.—October 6th. P.M.G.'s Department. Instruments and parts (schedule 499). (September 10th.)

South Australia. — October 20th. P.M.G.'s Department. Telegraph instruments (schedule 546), and telephone instruments (schedule 549). (September 10th.)

November 3rd. P.M.G.'s Department. Telephone instruments (schedule 548). (September 10th.)

Edinburgh. — September 27th. Electricity Supply Department. Coal, ash and flue-dust handling plant, circulating pumps and pipework. (August 27th.)

Rosslynlee.—Midlothian and Peebles District Asylum. Stores, including electric fittings. Forms of tender from the Clerk, 19, Heriot Row, Edinburgh.

France. — October 1st. The French State Railway Authorities (Service Electrique 3rd Division) 88, Rue de Rome, Paris, 3,700 electric connections for conductor rails, in bare copper cables of 400 sq. mm. section, and 7,100 of 200 sq. mm. section.

October 6th. French Post and Telegraph Authorities (Direction de l'Exploitation Telephonique). 103, Rue de Grenelle, Paris. 72 lots of paper-insulated telephone cable.

October 13th. The French Post and Telegraph Authorities (Direction de l'Exploitation Telephonique) 103, Rue de Grenelle, Paris. Eleven lots of high-conductivity copper wire, 2½ mm. dia., annealed copper wire, 1 and 2 mm. dia.; bi-metallic wire, 3 mm. dia., and annealed iron wire, 1 mm. dia.

India. — Agra. — October 22nd. Municipal Board. Complete generating plant, comprising: four Diesel engines and h.t. alternators; h.t. and l.t. switchgear, transformers and sub-station equipment; 15 miles underground h.t. cables, 28 miles overhead l.t. three-phase mains and street lighting equipment complete with all accessories. (August 20th.)

Lincoln. — October 8th. Electricity Department. Spray cooling plant, 500,000 gallons per hour, with pipe and pipework. (September 10th.)

Littleborough. — September 22nd. Urban District Council. Transformers, switchgear, &c. (September 10th.)

London.—Metropolitan Asylums Board.—September 29th. Extensions to the telephone installation at the Grove Hospital, Tooting. (September 10th.)

Manchester.—September 20th. Electricity Committee. Six 33,000-volt, 19,500-K.V.A., 3-phase static transformers, house service and testing transformers. (August 6th.)

October 8th. Electricity Committee. Specification No. B.9. Five 8,500 K.V.A. 3-phase transformers and fans, &c.; and three 6,000 K.V.A. 3-phase transformers and fans, &c. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

Nuneaton.—September 20th. Electricity Department. H.T. and L.T. switchgear, connecting cables and accessories. (August 13th.)

Sheffield.—October 12th. Electric Supply Department. Two 10,000-KW. steam turbines, condensing plants, pipework, &c., alternators and exciters. (September 10th.)

St. Helens.—September 30th. Electricity Department. Cast-iron low pressure water piping, and one natural draught cooling tower. (September 10th.)

CLOSED.

Australia.—Perth.—The tender of Messrs. C. A. Parsons and Co., Ltd., of Newcastle-on-Tyne, has been accepted by the West Australian Government for the 7,500-KW. turbo-alternator for the Perth central power station.—*Tenders.*

Blackburn.—Board of Guardians. Accepted :—

C. T. Briscoe & Sons.—Electric light installation at the Workhouse Infirmary, at £1,259.

Bradford.—Tramways Committee. Accepted :

Tram rails and crossings, £6,329.—Hadfields, Ltd., Sheffield.
20 tons of cast-cross brake blocks, £36 10s. per ton.—Miller & Co., Ltd.

Norway.—The Norwegian Government has placed an order for 930 miles of electric cable with the A.S. Skandinaviske Kabel og Gummifabrikker, that firm's tender being 10 to 20 per cent. lower than its native and foreign competitors. The firm has also secured a Dutch contract for 217 miles of cable for the Dutch Indies, as well as a number of small contracts for this country.—*Electricité.*

Spain. — La Sociedad Espanola de Construcciones Metálicas has obtained the adjudication for the construction of the three electric cranes for which tenders were invited by the Works Board of the port of Gijón. The company undertakes to use either Siemens-Schuckert electrical material at a price of 393,400 pesetas, or that of the Metropolitan-Vickers Electrical Export Co., at 365,000 pesetas.—*Reuter's Trade Service* (Madrid).

Stafford.—Town Council. Accepted :—

A. B. Lyell & Co., for the laying of a 24 in. diameter condenser, for the electricity works, £2,023.

Sunderland.—Town Council. Accepted :—

Albion Clay Co.—500 yds. 3-way, and 120 yds. 6-way stone-ware ducts.
Ferranti, Ltd.—72 consumers' meters.

FORTHCOMING EVENTS.

Iron and Steel Institute.—September 21st to 24th. At the S. Wales Institute of Engineers, Cardiff. Annual conference.

Machine Tool & Engineering Exhibition at Olympia, W.—Last day, September 25th.

NOTES.

Educational.—London County Council.—Hackney Institute, Dalston Lane, E. 8.—The new session commences on September 20th. Evening lectures and laboratory courses are held in electrical engineering, including electrical measurements, motors and dynamos. For particulars, see our advertisement pages to-day.

Messrs. S. Rentell & Co. inform us that their standard work, "The Practical Electrician's Pocket-Book," has now been included in the list of books which are officially recommended by the City and Guilds of London Institute.

The Patent Office Library.—We note with much pleasure that on and after October 1st, the hours of opening of the Library will be from 10 a.m. to 9 p.m., except on Christmas Eve and Easter Eve, when the Library will be closed at 4 p.m.

Service Notes.—The following appointments of Royal Engineer officers have been made to the School of Electric Lighting : — Chief instructor, Major P. S. Watkins, D.S.O.; instructors, Captain and Brevet-Major E. O. Alabaster and Captain and Brevet-Major H. S. Briggs, O.B.E.; Anti-Aircraft and Sound Location School instructor, Captain and Brevet-Major K. R. St. J. J. ffrench-Mullen.

Birmingham Electric Club.—The Birmingham and District Electric Club held its first meeting of the session at the Grand Hotel, on Saturday, September 11th, when a paper was read by Mr. R. Gregory upon "Some considerations in regard to low-tension switchgear." The paper was very exhaustive, and dealt particularly with automatic protection of electrical machinery. The forms of protective devices mentioned and explained were, protection against overload, failure of supply, reversal of current, leakage to earth, and for emergency purposes. Each class of protective gear was analysed and explained. Mr. Gregory said that during the past few years much progress had been made in accuracy of design, robustness of construction, and range of patterns.

Ex-Soldiers' Training.—The *Morning Post* states :—The scheme administered by the Ministry of Labour for the training of ex-Service men whose apprenticeships were interrupted by war service has been successfully conducted. The statistics available indicate that many employers of labour, not unmindful of the country's obligations to those who played their part in the war, have sympathetically co-operated. Up to the end of August, 41 schemes had been approved, and applications had been received in respect of all of them. The number of applications received at Employment Exchanges from employers for apprentices was approximately 43,500, while the number of applications received from apprentices was about 49,000. During the same period agreements had been received in respect of 42,000 apprentices, and grants had been sanctioned for 40,000 apprentices employed by 16,000 employers.

It is announced that applications by ex-Service apprentices to come under the scheme must be received at Employment Exchanges not later than the 30th inst. Employers who wish to bring ex-Service apprentices under this scheme must lodge their applications by the same date. Applications received after that date cannot be considered. This regulation will not apply to : (1) Apprentices demobilised after July 31st, 1920. In this case applications will be received if made within two months of the date of demobilisation, and special consideration will be given to such cases. (2) Employers who make application to bring under the scheme apprentices whose applications are lodged at the Employment Exchange not later than the dates specified above.

Appointments Vacant.—Engineer and manager (£450 + 5 per cent. on the net profit) for the Bacup Corporation electricity department; assistant mains engineer (360 taels per month—tael = 5s. 8d.) for the Shanghai Municipal Council electricity department; assistant electrical engineer, $450 (Straits Settlements currency) per month, dollar = 2s. 4d., for the Singapore Harbour Board; plumber-jointer, for the Farnworth U.D.C. Electricity Department. See our advertisement pages to-day.

Workmen's Holidays.—Sunderland Town Council has agreed to the proposal of its skilled workmen who are on strike that the question in dispute—whether these men are entitled to an annual holiday with pay, the same as other classes of labour whose conditions of service are directly settled by the Corporation and not by Trade Union conditions - shall be referred to an arbitrator to be appointed by the Ministry of Labour under the Industrial Courts Act. In the meantime, the men have resumed work. The strike of the car-shed men at the tramway depôt over this question has lasted nine weeks.

Fatality.—At an inquest held at Stockton-on-Tees, on September 6th, on Michael McKenna, aged 49, a mine filler employed at the Tees Bridge Works, it was stated that deceased was found lying on the ground grasping in his left hand a hook with which he had been drawing lime from the kiln. One end of the hook was resting on a pipe covering an electric cable. Charles Harrison, another mine filler, said he tried to knock the hook away, but got a shock. When he tried to lift deceased he had to put him down again, as he received another shock. The medical evidence was that death was due to asphyxia following electric shock. The doctor expressed the opinion that if deceased had died from natural causes, he would not have held on to the hook. The Jury returned a verdict of "Electrocuted whilst following his employment."

INSTITUTION NOTES.

The Institute of Metals.—At the annual autumn meeting of the Institute, held at Barrow-in-Furness, on Wednesday, Mr. H. B. Weeks, F.I.C., read a note on "Brass Foundry Practice at Messrs. Vickers, Ltd., Barrow-in-Furness." He described the brass foundry and the progress that has been made therein during the last 50 years. He dealt with loose pattern moulding, plate moulding, "dry" and "green sand" work, loam moulding, chill moulding, and dressing and fettling, including sandblasting. Reference was also made to the premium bonus system which is in operation.

Messrs. T. G. Bamford, M.Sc., and W. E. Ballard, read a paper on "The Influence of Gases on High-Grade Brass." Large-scale casting experiments were carried out to determine under what thermal conditions of casting the porosity due to gases could be eliminated. Provided the pouring temperature was maintained as high as 200° C. above the liquidus porosity due to gases was absent.

A "Note on a Failure of Manganese Bronze," by Mr. J. H. S. Dickenson, related to the examination of a "Manganese-Bronze" end-plate from a turbo-alternator rotor which failed in service. It was found that certain fractured peripheral projections had been rendered brittle by the contact of fluid solder which had penetrated along the junctions of the crystalline grains. The end plate was shown by analysis and micro-examination to be a typical beta brass of simple polyhedral structure. Bend tests taken from the inner, unaffected, portions showed toughness and ductility whether tested at the room temperature or as high as 200° C., but they collapsed instantly under small loads, with an intergranular fracture and no appreciable distortion, if heated sufficiently to melt the point of a stick of soft solder applied to the side in tension. No such effect was obtained when solder was melted on the side in compression, or when a test piece was soldered on the tension side and stressed with the solder in the solid state. It was found that there had been local heating in the rotor, and the solder appeared to have penetrated while the beta-brass end-plate was running under stress.

An investigation followed to elucidate the conditions under which alloys of the "Manganese Bronze" type, *i.e.*, beta brasses, as well as alpha and mixed brasses, are prejudicially affected by contact with fluid solders, the special points on which information was required being to ascertain the stress required to produce failure, and also to what extent variation in composition and microstructure affected the result.

The effect of bringing fusible alloys (melting at 69·5° C. and 93° C.), soft tin-lead solder, and tin into fluid contact with heated and stressed test bars of various kinds of brass was ascertained. In all cases the result was greatly to reduce the maximum stress and cause intergranular fracture, this being by far the most marked in the case of beta brasses of simple polyhedral structure, less so when alpha and beta constituents occur together, and to nothing like the same extent in alpha brass with interlocking crystalline grains. These differences form a further example to show the danger of permitting metallic crystals to develop smooth and regular outlines. It is suggested that further work in this direction may throw additional light on the phenomenon of season cracking.

In a paper by Messrs. O. F. Hudson, D.Sc., and J. H. Darley, on "The Constitution and Structure of Certain Tin-Antimony-Copper Alloys," the authors dealt with bearing metals of a particular composition (tin, 89 per cent.; antimony, 8·7 per cent.; and copper, 2·3 per cent.), principally with a view to ascertaining if any rules could be formulated connecting easily-recognised variations in structure with definite casting conditions. They considered that the essential condition for the production of a coarse angular type of structure in bearing alloys was undisturbed cooling from a particular temperature, and that the casting temperature of a white metal bearing should not exceed this critical temperature. The critical temperature will depend on the composition of the alloy, and in the case of the alloy used in these experiments it lay between 300° and 350° C. In other alloys, in which solidification begins at higher or lower temperatures, the critical temperature will be correspondingly higher or lower, but generally the angular type of structure will result when the casting temperature is about 50° C. above the temperature at which the alloy begins to solidify.

Union of Engineering and Shipbuilding Draughtsmen.—The Halifax branch of the Union visited the Corporation electricity works, last week-end, by invitation, and under the guidance, of Mr. Rogerson, the manager.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Swansea University College Council has made the following appointments:—Professor of Engineering (commencing salary, £900 per annum): MR. FREDERICK BACON, M.A. (Cantab), A.M.Inst. C.E., M.I., M.I.E.E., Draper's Professor of Engineering at University College, Cardiff. Lecturer in Electrical Engineering: MR. R. G. ISAACS, B.Sc. (Eng.) (London), A.M.I.E.E., of the Swansea Technical College. Assistant Lecturer in Electrical Engineering: MR. J. LLOYD DAVIES, B.Sc., (Eng.) (London), of the Swansea Technical College.

MR. T. H. DENNIS, M.I.E.E., managing engineer of the Straits Trading Co., Ltd., has recently arrived in England from Singapore on long leave.

MR. W. D. BRASSINGTON, Motherwell, has been appointed electrical engineer at Motherwell at a salary of £500.

Last Friday evening, at Phœnix Park Sports Club, Bradford, a large gathering of employés of the aircraft department (now being closed down) of the Phœnix (Thornbury) Works of the English Electric Co., Ltd., presented a smoking cabinet to MR. ARTHUR FORD, manager of the metal shop.

It is stated that, under the age limit (65), MR. TOM MANN is to retire in April next from the general secretaryship of the Amalgamated Engineering Union.

MR. G. CONFORTI, general manager of the Pirelli General Cable Works, Southampton, who is leaving, has been presented by the staff with a gold watch, and by the employés with a gold albert.

The marriage took place at Heddon-on-the-Wall, on September 4th, of MR. ARTHUR CHARLES RAYMENT, A.M.I.E.E., to Miss Winifred E. Bolam.

The Manchester Guardian, on Friday last, stated that on Saturday the Chairman of the Manchester Electricity Committee (ALDERMAN DAGNALL) and MR. PEARCE would leave Southampton in the *Aquitania* for a tour of the States and Canada. "The itinerary is a long one, and will include New York, Boston, Pittsfield, Schenectady, Albany, Philadelphia, Washington, Pittsburg, Chicago, Detroit, Buffalo, Niagara, Hamilton, Toronto, and Montreal, with several smaller places sandwiched between them. Primarily the idea is to investigate the most modern practice in regard to the design and operation of large generating stations for economical production—points that may be valuable at Barton—but the skilled eye will be on the alert for all manner of other information. It is hoped, for instance, to gain considerable knowledge about staff organisation, and about modern transmission and distribution systems and modern sub-station practice."

Nelson Town Council has increased the salary of the electrical engineer and tramways manager from £601 to £750, of which amount £297 is to be regarded as war bonus.

MR. W. H. BLYTHE, research electrical engineer, Brooklands, Cheshire, and MR. JOHN H. HAVELOCK, Blackpool, chief instructor in engineering, R.A.F., have been appointed travelling teachers in mechanical and electrical engineering by the Glamorgan Education Committee.

Obituary.—MR. T. J. S. CLEPHAN.—The death took place on September 10th of Mr. Thomas James Seddon Clephan, electrician, who had since 1873 carried on business at Standishgate, Wigan. He was in his 75th year.

MR. HUGH STEWART, who has died at Boyle, Co. Roscommon, introduced electric lighting in that town about 20 years ago, and was also responsible for the introduction of electric lighting in Coalisland, Co. Tyrone.

CITY NOTES.

Stock Exchange Notices.—The committee has ordered the following to be officially quoted:—

Newcastle-upon-Tyne Electric Supply Co., Ltd.—1,000 5 per cent. preference shares (non-cumulative) of £1 each, fully paid (Nos. 1,442,952 to 1,443,951).

Lima Light, Power & Tramways Co.—Profit and loss account shows the following results: Total profits obtained during 1919 £p253,252, less bond service £p52,130, bond amortisation during 1919 £p48,315, European expenses £p1,644, interest and discounts £p3,245, provision for bad and doubtful debts £p3,000, leaving a net profit of £p154,918; balance brought forward from 1918 £p95,064, makes a total of £p249,982. From this the board has made following deductions: Dividends distributed on share capital £p107,990, cost of stores £p10,000, cost of extraordinary repairs £p10,000, expenses of bond issue £p16,900, reserve for bad and doubtful debts £p10,000, leaving a balance of £p95,091, which amount is to be carried forward.—*Financier.*

Bruce Peebles & Co., Ltd.—Dividend at the rate of 7½ per cent. per annum, less income tax, on the cumulative participating preference shares for the half-year ended June.

Calcutta Electric Supply Corporation, Ltd.—The number of units sold to consumers has been as under:—

	1920.	1919.
Four weeks ended May 28th	3,198,656	2,687,034
Four weeks ended June 25th	3,263,077	2,609,749
Five weeks ended July 30th	4,207,686	3,380,053

Nairobi Electric Power & Lighting Co., Ltd.—Interim dividend at the rate of 4 per cent., less tax, for the year.

Spain.—The total receipts of the Compañia Sevillana de Electricidad during the past financial year, including those derived from the Eléctricas de Jerez, amounted to 6,508,109 pesetas. These figures show a considerable increase, while expenses diminished to 4,124,382 pesetas. The net profits totalled 1,108,457 pesetas, and a dividend of 5 per cent. has been declared.—*Reuter's Trade Service, Madrid.*

Prospectus.—*Major & Co., Ltd.*—The list is to close on Monday next in an issue of 100,000 8½ per cent. cumulative preference shares, and 60,000 ordinary shares, all of £1 each, at par. The proceeds will be used to pay off existing loans and provide funds for the completion of extensions now in hand and for further working capital.

Eastern Telegraph Co., Ltd.—Dividend at the rate of 3½ per cent. per annum, less tax, for the quarter, on the preference stock, and a second quarterly dividend of 2½ per cent. on the ordinary stock, free of tax.

Manila Electric Railroad & Traction Corporation.—Dividend of 1½ per cent. on the common capital stock for the quarter ended September.

Madras Electric Tramways (1904), Ltd.—Interim dividends 6 per cent. per annum, less tax, on the preference and 8 per cent. per annum, free of tax, on the ordinary.

Globe Telegraph & Trust Co., Ltd.—Quarterly interim dividend of 3s. per share on the preference shares, less tax, and 5s. per share on the ordinary, tax already deducted.

Mackay Companies.—Quarterly dividends of 1 per cent. on preferred and 1½ per cent. on common stock.

British Insulated & Helsby Cables, Ltd.—Dividend 9d. per share, less tax.

Calgary Power Co.—The gross revenue for 1919 was $296,564, against $275,864 for 1918. Operating expenses, bond interest and other charges properly payable out of revenue absorbed $206,835, leaving a net profit of $89,729, as against $82,490. The net profit has been carried to surplus account. After appropriating $50,000 for depreciation and bond discount the balance remaining at the credit of that account and carried forward to 1920 was $181,167. The net earnings for the past year were the largest in the history of the company, but they do not, in the opinion of the directors, warrant the payment of a dividend.—*Financial Times.*

The A.E.G.—An extraordinary general meeting of the Allgemeine Elektricitats Gesellschaft on September 11th sanctioned the increase of its capital to 550,000,000 marks by the issue of 175,000,000 marks worth of preference shares immediately, and an additional 75,000,000 marks worth later.—*Reuter.*

Claud Hamilton, Ltd.—Dividend and bonus 15 per cent., less tax; £14,082 is carried forward (subject to excess profits duty).

Western Telegraph Co., Ltd.—Dividend of 7s. per share, making a total of 10 per cent., free of tax, for the year ended June, 1920.

STOCKS AND SHARES.

Tuesday Evening.

Following upon the brightness shown by the Stock Exchange markets since we last wrote here, a very different set of conditions has developed. At the beginning of this week, the investing public began to press industrials for sale—possibly in a fashion rather unreasoning. The effect was seen in a fairly general fall, and the weakness spread over wide areas of securities. British Government stocks gave way on the assumption that in the event of a strike in the Triple Alliance, there might be substantial sales from the Trades Unions, for distribution of the cash as strike pay. But the truth of the matter demands no profound search, for it is obvious enough that with a national crisis in the air, people would rather keep their money in the banks than invest it in stocks and shares.

Amidst the heaviness in most departments, there are several notable exceptions, of which Mexicans and dollar stocks of all kinds are the chief. The advances in Mexican securities are connected, of course, with the election of the wealthy and powerful General Obregon as President. Prices have risen from 3 to 5 points in the Utility issues. Of those not quoted in our lists, Pachuca Fives have improved to 45½, and Mexican Electric Light 5 per cent. bonds to 46½. Singularly, Monterey Fives eased off to 29½, after being higher.

Interest payments on most of these Mexican Utility bonds have been suspended for something like six years, and it becomes a lively question as to how the arrears can be dealt with. The preferred stock of the Mexican Light & Power Co. is cumulative, and, having received nothing for seven years, the stockholders are entitled, on this alone, to 49 per cent. at simple interest. Payment in cash of these outstanding debts sounds a Utopian idea, but of course the back-interest has to be arranged in some shape or form, and already rumour is busy with talk of funding schemes. These would provide—if carried out on conventional lines—for payment of arrears to be made in scrip, or bonds, that would themselves become redeemable in cash at some future date. The mere discussion of such a thing may savour of prematurely intelligent anticipation, but in a new Mexico, where peace shall supersede seven years of chaos, such matters are bound to be amongst the earliest subjects for settlement if more foreign money is to be tempted into the country.

Rises in the "dollar securities" continue apace. Shawinigan Water is up to 136½, with business recorded at this price. West Kootenay Power & Light Sixes marked as high as 110½. Havana Electric Tramways 5 per cent. have improved to what looks to be the fancy figure of 112½. Sao Paulo Tramways Fives have risen to 92½. They are redeemable in 1929. The company's 5 per cent. consolidated debenture stock stands at 58½.

The London lighting list is no exception to the heaviness elsewhere—a heaviness which, by the way, was inclined to lift a trifle at the close of business this (Tuesday) evening. Of course, it would be nothing short of a miracle were prices of electricity supply shares to display any firmness in the face of the lock-out on the employers' part, and the threatened retaliation by the men. Chelseas and Metropolitans are both ½ lower. The latter changed hands the other day as low as 50s., which is half their nominal value. Amongst the dollar securities, Consolidated Gas & Electric of Baltimore shares are 6 higher at 134½, the bonds being advanced 3 points to 106½. It may be of interest to observe that in quoting such dollar stocks *ex* dividend, the Stock Exchange calculates the dollar as worth about 5s. 6d. at the present time.

Metropolitans and Underground income bonds are both better, on anticipation of the benefit which will accrue to the companies through the raising of fares which is to come into force at the end of next week. The 'bus fares are also to be increased, which will, of course, have a beneficial effect upon takings of the group at large. As it has been so often pointed out, the tubes and 'buses carry such vast numbers of passengers nowadays that the addition of a very little extra cost per passenger may make all the difference between the companies running at a loss and at a substantial profit. Underground income bonds have recovered to 57½, and in them there is probably more scope for improvement than in any other stocks of the Underground companies. Amongst the foreign traction issue, little change has occurred. Bombay preference hold their recent rise at 13½. Brazilian Tractions are a rather unsteady market, while in Anglo-Argentines there is nothing doing.

Anglo-American Telegraphs are easier again, but the Eastern group holds its prices. Various of the dollar securities in the telephone and telegraph list are better. Marconis went back to 2 11/16, influenced chiefly by the prevailing dulness round the House in consequence of the coal position. In the telegraph manufacturing shares, Henley preference at 3½ show a fall of 2s. 6d. Siemens are a little better at 24s. 6d. Of the others in this market, Edisons are steady at 20s. General Electric ordinary receded to 27s. 6d., Babcock & Wilcox to 2 5/16. Armament shares have been pressed for sale, more especially Vickers, where some of the larger holders in the North of England have been rather fidgetty since the passing of the interim dividend. Rubber shares are dull, in consequence of the flatness of raw rubber at a shade below 1s. 8d. per lb. The prophets are agreed that there is every reason to look for a material rise in the price of the produce, and that conditions point to the present price being unduly depressed, some declaring it to be purely artificial. The only thing which declines to respond to the unanimous consensus of opinion that rubber is too cheap, is the price of rubber itself.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Sep. 14, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	6½xd	—	£9 19 0
Charing Cross Ordinary	4	7	8½	—	10 15 6
do. do. do 4½ Pref.	4½	4½	9½	—	8 8 8
Chelsea	3	4	9½	— ½	7 12 5
City of London	8	10	14	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	17½	—	10 9 10
do do. 6 per cent. Pref.	6	6	8½	—	7 8 0
Kensington Ordinary	6	7	8½	—	9 0 6
London Electric	Nil	2½	14	—	8 0 0
do. do. 6 per cent. Pref.	6	6	8	—	10 0 0
Metropolitan	5	6	26	— ½	11 8 6
do. 4½ per cent. Pref.	4½	4½	21½	—	8 0 0
St. James' and Pall Mall	10	13	6½	—	9 1 2
South London	5	6	24	—	9 12 0
South Metropolitan Pref.	7	7	17/-	—	8 4 8
Westminster Ordinary	8	10	5	—	10 0 0
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	73½	—1	7 12 10
do. Def.	33/6	1½	17½	— ½	8 13 10
Chile Telephone	6	6	5½	— ½	*5 4 4
Cuba Sub. Ord.	7	7	7½	—	*9 6 8
Eastern Extension	8	10	142	—	*8 14 4
Eastern Tel. Ord.	8	10	149½	—	*8 14 4
Globe Tel. and T. Ord.	8	10	142	—	*8 14 4
do. do. Pref.	6	6	84	—	7 1 2
Great Northern Tel.	22	22	10	—	11 0 0
Indo-European	13	10	80	—	8 6 8
Marconi	25	25	2⅛	— 1/16	9 6 2
Oriental Telephone Ord.	10	12	24	—	*4 16 0
United R. Plate Tel.	8	8	6½	—	*6 1 0
West India and Panama	1/8	Nil	¼	—	Nil
Western Telegraph	8	10	14⅞	—	*6 14 4
Home Rails.					
Central London Ord. Assented	4	4	41½xd	—	9 12 10
Metropolitan	1	1½	29	+ ½	6 5 0
do. District	Nil	Nil	18	—	Nil
Underground Electric Ordinary	Nil	Nil	12	—	Nil
do. do. "A"	Nil	Nil	5/-	—	Nil
do. do. Income	5	4	57½	+1	—
Foreign Trams, &c.					
Anglo-Arg. Trams First Pref.	Nil	5½	8½	—	8 9 2
do. do. 2nd Pref.	Nil	Nil	8½	—	Nil
do. do. 5 Deb.	5	5	57½	—	8 13 6
Brazil Tractions	Nil	Nil	47⅛	—	Nil
Bombay Electric Pref.	6	6	13½	—	4 10 7
British Columbia Elec. Ry. Pfce.	5	5	52½	—	9 10 6
do. do. Preferrred	2½	5	49½	—	*7 4 4
do. do. Deferred	Nil	5	49½	—	*7 4 4
do. do. Deb.	4½	4½	65	—	7 14 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	45	+3	Nil
do. 6 per cent. Bonds	Nil	Nil	35	+5	Nil
Mexican Light Common	Nil	Nil	16	+3	Nil
do. Pref.	Nil	Nil	27½	+4	Nil
do. 1st Bonds	Nil	Nil	57	+4	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	2 5/16	— 1/16	*6 9 10
British Aluminium Ord.	10	10	1 15/16	—	10 0 0
British Insulated Ord.	12½	15	13½	—	8 5 6
Callenders	25	15	12	—	11 8 6
" 6½ Pref.	6½	6½	18/-	—	7 4 5
Castner-Kellner	20	17	8	—	5 18 4
Crompton Ord.	10	10	17/6	—	11 8 6
Edison-Swan, "A"	10	10	11	—	10 0 0
do. do. 5 per cent. Deb.	5	5	78½	—	8 5 9
Electric Construction	10	10	18/3	—	10 19 2
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 5
do. Ord.	12	10	13	- 9d.	*7 5 7
Henley	25	15	12	—	6 11 5
do. 4½ Pref.	4½	4½	8½	— ½	7 4 0
India-Rubber	10	10	1½	—	*8 0 0
Met.-Vickers Pref.	—	8	24	—	7 6 2
Siemens Ord.	10	10	24/6	+6d.	*6 3 8
Telegraph Con.	20	20	20	—	*6 0 0

* Dividends paid free of Income Tax.

THE BRITISH ASSOCIATION.—IV.

The Testing of Materials at High Temperatures.

By Prof. F. C. Lea. (*Abstract.*)

Section G.—Engineering.

Experiments on metals carried out by the author at Birmingham have included, *inter alia*, tensile tests, and hardness tests at temperatures varying from 0 deg. C. to 900 deg. C. in the former case and to 500 deg. C. in the latter. From the tensile tests have been obtained:—

1. The breaking strength.
2. The elastic limit.
3. The yield point (when possible).
4. The modulus of elasticity.
5. Elongation per cent.

The tests have been carried out in electrically-heated furnaces. One furnace used has a porcelain tube 2¼ in. diameter, 24 in. long, wound with a platinum strip. Such furnaces are expensive, and satisfactory porcelain tubes are not easy to get. The one mostly used consists of a steel tube 4 in. outside diameter, ⅛ in. thick, wound non-inductively with nichrome wire. This is insulated from the steel tube by strips of uralite laid along the tube. The whole is encased in asbestos wool, and a covering tube of tin, which is again covered with asbestos cloth. Two circular plates held together by four bolts, and to which the terminals, suitably insulated, are connected, complete the ends of the furnace. No trouble has been experienced with these furnaces even when working with temperatures well over 700 deg. C. For the hardness tests the furnace shown in fig. 1 was constructed. This is very similar in construction to the furnace just described except that at one end it has a heavy anvil and at the other end a guide for the plunger. When being used on the Brinell machine, the anvil is insulated by asbestos. A standard steel ball 10 mm. in diameter is attached to the plunger. A small transverse tube pierces the cylinders of the furnace to allow the thermo-couples to enter the furnace conveniently. Temperatures were generally measured by iron-constantan or copper-constantan thermo-couples.

Aluminium Alloys.—The use of aluminium alloys for parts of motor car and aeroplane engines has made it necessary to inquire carefully into the effect of temperature on such alloys. Copper, manganese, nickel, and magnesium have a considerable effect in hardening aluminium alloys, and increasing their strength at temperatures above 150 deg. The high percentage zinc alloys diminish in hardness so rapidly that they are not of much use for pistons. Alloys that maintain a hardness number of, say, 28 at 300 deg. C. appear to be quite suitable for pistons and have given good results in flight.

Alloys containing from 8 to 12 per cent. of copper should give this hardness number, and those containing lower percentages of copper with nickel and magnesium, or iron and magnesium give much higher hardness numbers at this temperature. They are, however, much more troublesome in the foundry. At the temperature of 300 deg. the hardness is practically independent of whether the alloy has been sand or chill cast.

Steel and Reinforced Concrete.—The importance of studying the effects of temperature on materials becomes significant in connection with the attempts made to construct fireproof buildings.

Results obtained from tests of mild steel, which had actually been supplied for reinforced concrete, show that the breaking strength at zero degrees Centigrade was 30 tons per sq. in. The maximum strength was obtained at about 235 deg. C. No attempt was made to determine this actual temperature with very great precision, but from other experiments on quenched and tempered steels containing from 0.48 per cent. carbon to 1.2 per cent. carbon there seems every indication that at about this temperature a "peculiar" point occurs on the curve of breaking strength.

At temperatures beyond 300 deg. C. the strength diminishes very rapidly, and at a temperature, from 615 deg. to 640 deg. C. the breaking strength is less than 7 tons per sq. in. The actual temperature at which the fracture takes place at this stress depends upon a time factor of heating and loading.

The breaking strength of the steel reaches the design working stress of 7 tons per sq. in. at a temperature very little more than 600 deg. C., and there seems no doubt that if the beams and slabs are fully loaded failure is bound to take place when the steel reaches a temperature approximating to 650 deg. C. This, then, is a fundamental fact of importance in considering this question of fire-proofing. If the concrete covering is too thin, or if it cracks and fritters under the temperature to which it is exposed, then the steel must quickly reach the dangerous temperature. On the other hand, if the steel can be kept below this dangerous temperature for a certain length of time, during which the worst part of the fire may have spent itself, then the building is likely to survive.

None of the tested alloys, even at ordinary temperatures, show any very definite yield until long after the elastic limit of the material has been passed. In fact, of nearly all the alloys, it can be said that yield point as usually understood has no real meaning. The effect of temperature on the elastic modulus and on the form of the stress-strain curve is very noticeable, and in some cases may be more important than the effect on the ultimate strength. For example, the strength of manganese bronze is reduced from 32.5 tons per sq. in. at ordinary temperatures to 12.6 per sq. in. at 350 deg. C. while its elastic limit is reduced from 6.3 tons per sq. in. to less than 0.4 ton per sq. in. Permanent set begins to take place even at very small loads, and at a very low stress creep with time is noticeable. The following particulars are of interest:—

Delta Metal.

Temperature.	Ultimate strength. Tons per sq. in.	Modulus of elasticity. Tons per sq. in.	Elastic limit. Tons per sq. in.
15	32·65	6·890	4·6
250	28·0	6·290	2·8
350	18·6	3·870	0·8
450	7·52	No definite value	less than 0·2

Ultimate Strength and Hardness.—The author thinks he may claim to have been the first to determine the hardness numbers of metals at high temperatures. The furnace shown in fig. 1 has been used in these determinations.

The results obtained are of very considerable interest in connection with nearly all the alloys. Alloys of copper and nickel maintain their hardness to a temperature of 450 deg. in a remarkable manner, while nearly all the ordinary copper alloys diminish very rapidly in hardness at temperatures beyond 250 deg. C. Nickel steel maintains its hardness better than all the alloys except the two mentioned.

There is a striking similarity between the curves in all cases. For monel metal, strength, elastic limit and modulus of elasticity are, exactly like the hardness, affected to a much less degree by temperature than the same quantities for the other copper alloys.

At 500 deg. C. its breaking strength, elastic limit and modulus of elasticity are all more than 80 per cent. of the same quantities at ordinary temperatures. Both hardness and breaking strength are maintained by nicro-copper, which contains only 2 per cent. of nickel.

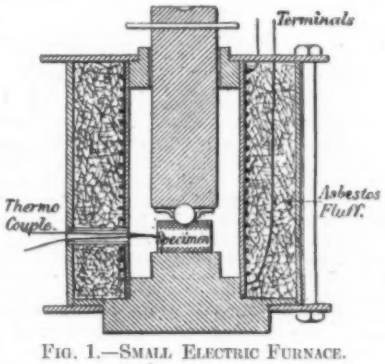


Fig. 1.—Small Electric Furnace.

The remainder of the paper is devoted to a record of similar tests carried out on blocks and cylinders of concrete and cement. The questions presenting themselves are: —

Is it possible to obtain a covering for beams, slabs, and columns that will not readily crack, and is such a bad conductor that it will prevent the steel and concrete from reaching dangerous temperatures? If not, can other means be found for keeping the reinforcement cool in case of fire? These questions have not been answered, and probably the answer, if found at all, will only be found after considerable research. The final answer will not be found in the engineering laboratory, but as in other engineering problems, a good deal of light can be thrown upon this one by small scale laboratory experiments. As far as the steel is concerned, the tests detailed clearly indicate that its temperature must be kept below 650 deg. C. If some of the alloy steels ever become cheap enough and can be used for reinforced concrete, slightly higher temperatures may be allowable without risk of failure, but then advantage could not be taken of the high breaking strength of these alloys at ordinary temperatures if the failing stress under temperature is still to be 7 tons per sq. in.

The Efficiency of Transmitting Aerials and the Power Required for Long-distance Transmission.

By Prof. G. W. O. Howe, D.Sc. (*Abstract.*)

Section G.—Engineering.

Of the total power supplied to the aerial of a transmitting station a portion is dissipated in the resistance of the wires constituting the aerial, tuning coils, secondary winding of the oscillation transformer, and earth or counterpoise wires, a portion is dissipated in imperfect dielectrics situated in the

electric field, such as wooden masts, buildings, soil, &c., and a portion is radiated. The resistance of wires can be calculated with considerable accuracy, and losses due to radiation can also be computed, but it is very difficult to form even a rough estimate of the dielectric losses. Radiation resistance is inversely proportional to the square of the wave-length. With regard to the dielectric losses it is known that the power-factor of a condenser is approximately independent of the frequency. Hence the product of the square of the R.M.S. current, and dielectric resistance bears a fixed ratio to the product of the R.M.S. current and the aerial voltage. Dielectric resistance is therefore inversely proportional to the frequency or directly proportional to the wave-length. The resistance of the wires can be made small, and it is less dependent on the frequency than the radiation and dielectric losses. If the wave-length were increased by inserting additional turns in the inductance, the conductor resistance would thereby tend to increase, but this would be counteracted to some extent, if not entirely, by reduced skin-effect. The total resistance is a minimum (R_m) for that wave-length (L_m), at which the dielectric losses are twice the radiated power. From the observed values of the total effective resistance of the aerial at three different wave-lengths it should be possible to determine the three component resistances, but the measurements would have to be made with special care to give accurate values. If it be assumed that the resistance of the wires be negligibly small, the radiation resistance is a third of the measured total resistance, and the effective height may be calculated, taking certain assumptions into account.

A formula thus arrived at has been applied to data given in *Bulletin No.* 9 of the U.S. Bureau of Standards, with the following results:—

Aerial.	Length. Metres.	Capacity 10^{-9} farads.	Height. Metres.	L_m	R_m	Effective Height.
Bureau of Standards, harp	42·6	1·26	54·8	700	11·5	34·3
Signal Corps, flat top	44·5	1·71	39·6	1,300	6·7	48·5
Capitol, flat top	85	2·32	44·2	1,000	7·0	33·0
Navy Yard, harp	51·8	0·73	54·8	900	5·0	29·4
U.S.S. *Maine*, flat top	32·9	1·25	38·4	800	2·25	17·4
U.S.S. *Massachusetts*, flat top	34·4	1·10	39	1,000	2·75	24·1
Arlington, sloping top	—	9·4	(137) to (183)	7,000	1·1	107

The wire resistance, although assumed to be negligible in these calculations, is not so, but in the absence of further data it can only be said that the actual values of the effective heights must be less than these calculated values, and in some cases probably very much less. It has been stated that the Arlington antenna has an effective height of 137 metres, but how this was determined is not known; the above calculation indicates a much smaller value. It should be pointed out that this aerial is supported by three steel towers in which currents will flow in opposition to that in the vertical portion of the aerial, thus reducing the radiated power for a given aerial current and lowering, therefore, the effective height. Insulating the feet of the towers may reduce these currents to some extent, at the expense, however, of additional dielectric losses in the neighbourhood of the feet of the towers. The San Paolo aerial at Rome is supported by three wooden lattice towers 218 metres high, and it is stated that it has a minimum resistance of 3.25 ohms at a wave-length of 7,000 metres. Reception tests on a calibrated frame aerial indicate an effective height of 138 metres. Neglecting the wire resistance, the formula used above gives an effective height of 183 metres. To obtain 138 metres one must assume the conductor resistance to be 1.4 ohms. This is an improbably high value, and tends to confirm the doubt expressed in a paper read before the Institute of Radio Engineers as to the accuracy of the measured resistances with undamped waves.

It is evidently desirable that very accurate measurements should be made of the total effective resistance at various wave-lengths of different types of aerials making allowance for the high-frequency resistance of the aerial, tuning coils, and earth wires, or counterpoise. By making such measurements on aerials with steel masts and wooden masts, with earthing wires and insulated counterpoises, much valuable information would be gained as to the magnitude of the losses and as to the use or misuse of every kilowatt generated. With the limitations at present imposed by the stage of development reached in the construction of large thermionic valves, the last-named consideration is one of the greatest importance.

From the effective height, the root-mean-square current, and the wave-length, the radiated power can be calculated, and the ratio of this to the total power supplied to the transmitting aerial may be called the efficiency of the aerial. By inserting this ratio in a formula the total power required to produce a given received current in an aerial can be calculated. Further formulæ are given in the paper to show the further relationship of aerial efficiency to other factors, and figures are given to show that if a warship, with an aerial for which the wave-length at which the dielectric losses are twice the radiated power is 1,000 metres, transmits at a wave-length of 3,000 metres, less than 2 per cent. of the energy actually supplied to the aerial is radiated, the remaining 98 per cent. being dissipated in aerial losses. At a wave-length of 1,000 metres 30 per cent. may be radiated. Several tables showing the power required for various transmission distances are included in the paper, but it is explained that the figures are based upon the Austin-Cohen exponential factor, which is of uncertain application for distances greater than about 5,000 kilometres, and for wave-lengths exceeding about 10 kilometres. The tables and curves bring out clearly the enormous saving of power which can be obtained by using aerials with such small dielectric losses that the minimum total effective resistance is reached at long wave-lengths. For a given aerial there is always a wave-length at which the power necessary for a given distance is a minimum. At longer wave-lengths the inefficiency of the aerial more than counteracts the improved transmission.

Next Year's Meeting.

The next meeting of the Association will be held at Edinburgh, from September 7th to 14th. The president will be Sir T. E. Thorpe, Emeritus Professor of General Chemistry of the Imperial College of Science and Technology, South Kensington. Professors H. H. Turner and J. L. Myres, both of Oxford, have been reappointed general secretaries, and Sir Charles Parsons succeeds the late Lord Rayleigh as treasurer. In 1922 the Association will meet in Hull.

ELECTRICITY SUPPLY LEGISLATION IN HOLLAND.

The long-expected Government Bill for dealing with the electricity supply question in Holland has now been introduced in the Second Chamber of the States General by the Minister for Public Works. It is based mainly upon the suggestions of the Commission which inquired into the problem and presented a report in April, 1919, which proposes the creation of a semi-State undertaking for bulk production, and brings into existence an Electricity Council as an advisory organisation. The first article of the Bill, which is entitled "The Electricity Supply of the Country," provides for the formation of a joint stock company under the title of the Netherlands Electricity Works for the establishment and carrying on of equipment and works for the production of electricity which is to be rendered available to other parties, its transmission by means of primary high pressure conductors, and its transformation in sub-stations which are directly connected with the primary network. In special cases, however, the company is empowered to undertake the installation and operation of works for the distribution or supply of electricity. Shareholders in the company can only be (1) the State, (2) the provinces, or in place of these, companies whose object is to supply electricity and in which the preponderating influence is held by the provinces or the communal authorities, (3) the communal authorities, and (4) any trade which is indicated or permitted by the Crown. After hearing the Electricity Council, the Minister for Public Works will determine what high pressure conductors must be considered as primaries in the sense of this article.

It may be remembered that the Electricity Commission reported in favour of the whole production in general being entrusted to the State, but the Minister gives his preference to a central corporation for this purpose. The Commission also expressed the opinion that it would not be necessary by prohibition conditions to prevent parties other than the State from taking in hand production, transmission, and transformation in so far as these operations did not take place for their own use, but the Bill submits that the requisite unity in supply would not be obtained if the supply were left entirely free by the Government, and for this reason prohibition conditions are included with regard to the establishment and operation of equipment and works, as proposed in the first article, by other parties than the State and the holder of the concession, that is, the company. As the provinces for a considerable part will be dependent upon the company for the supply of energy, it is assumed that they will duly appreciate taking up a participation in the company because only in this way will they be able to obtain a joint right of determination in the management of the company, and in this manner, in the opinion of the Minister, the strongest argument brought forward by the Commission in favour of direct State working is deprived of its force.

It is considered that the composition of the shareholders in the company is such as in general will ensure that solely the public interests will be served by the company. The statutes will be drawn so that the State will have a majority of the shares, and thus possess a dominating influence in the company, upon which a concession must be conferred in order that it may properly discharge its duties. Conditions in the concession are to be included in the spirit of those which have already been granted to provinces and provincial companies, unless the close relations between the State and the company render necessary the adoption of conditions which deviate from the former. At the same time the Bill makes provision

for State working, if thought advisable, at some future period. Thus it is stipulated that if the Government thinks it will at any time itself directly take in hand the supply of electricity for which a concession is given, the necessary authority for this purpose will be found both in the terms of the concession and the statutes of the company.

It would so far appear as if the concessionnaire company is to possess a monopoly of bulk production for supply to distributing companies. This is, however, not necessarily the case. In this respect the Bill states that the concentration of the production of electricity, taking into consideration the large expenditure involved at the beginning, will only be able to be proceeded with in a gradual manner, and thus various parts of the country will remain outside the efforts of the company in the early stages of its existence. This being the case, it is obvious that the parts of the country which will derive no advantage from the system will also, in general, not experience any disadvantage if the undertakings which have already embarked upon the supply of electricity or which will take it in hand, are restricted in their freedom of movement no more than is completely necessary. As a consequence, the Bill empowers the Crown to grant concessions to parties other than the company for the erection of equipment and works as previously mentioned, and to exempt them from the conditions concerning the prohibition of such works.

The Bill provides for State participation in the company up to a maximum of 10,000,000 fl. (£833,000), and the existing State supply works are also to be incorporated in the company. The concessions already in existence will continue in force when the proposed law comes into operation, but from that time forward the threat of confiscation will hang over the generating stations, transmission lines, and sub-stations erected on the basis of such concessions. It is stated, for instance, that from the moment when the law becomes operative the Crown will be able, after hearing the Electricity Council, to withdraw the concessions in so far as concerns only the equipment and works referred to in the first article, thus leaving the existing companies in the position of mere distributors, dependent upon the semi-State company. One-third of the directors of the latter will have a seat on the Electricity Council, whose object is to advise the Minister of Public Works on all matters regarding the supply of electricity.

MODERN MARINE PROBLEMS.

By C. V. DRYSDALE, O.B.E., D.Sc., M.I.E.E.

(Abstract of the Eleventh Kelvin Lecture delivered before the Institution of Electrical Engineers.)

The Council of the Institution has decided that the time has now come for the Kelvin Lecture to embrace other fields than those of Lord Kelvin's personal activities. The lecture deals with the scientific investigations carried out in marine problems during and after the war by the Admiralty at its various experimental stations. Apart from the interest and importance of the subject there is a fitness in coupling it with the name of Lord Kelvin, who did so much for the submarine telegraph and for navigation.

The late war confronted this country with problems of the gravest character for which it was little prepared, and the vital necessity for enlisting the highest scientific talent of the nation in attempting to solve them was soon realised. The Institution co-operated enthusiastically in these efforts, both by the formation of its Anti-submarine Committee, and by the great personal service of many of its members in actual experimental work in the Admiralty stations and elsewhere.

During the latter part of the war there existed an efficient mobilisation of the scientific talent of the nation unique in the history of this country, and rapid advances were being made. Had this scientific force got into its stride in the early days, the history of the anti-submarine war at least might have been very different.

What we are fundamentally concerned with is the generation, propagation, and reception of impulses or disturbances through the sea, which may be either mechanical or acoustic, electrical, magnetic, electromagnetic, thermal, optical, chemical, or possibly radiant in character.

The sea, as being a greatly extended medium of high density and elasticity, affords excellent propagation of mechanical or acoustic impulses, but its relatively high conductivity due to its salinity offers a formidable obstacle to the transmission of all electromagnetic disturbances, except those of the lowest frequency. At the ordinary supply of frequency of 50 cycles per second about 94 per cent. the amplitude is probably absorbed in 100 metres. Optical, thermal, and other forms of radiation are rapidly absorbed by it, and chemical action is obviously local and rapidly diffused, so that the problem of detecting the presence of a noiseless submerged body is of a most difficult character.

The difficulty is greatly enhanced by the existence of disturbances which may easily mask the impulses it is desired to detect. As we are mostly concerned with objects within a few hundred feet of the surface, the reflections which take place owing to the great difference in the mechanical and electrical properties of the sea and the air frequently give rise to embarrassing interference phenomena, which are further complicated by surface waves; the same trouble is produced to a lesser extent by reflections from the bottom or from rocks in shallow water. Added to these disturbances are water noises caused by the waves and by the motion of an observing ship, or the noises caused by its machinery of propulsion, &c., as well as "earth currents" and magnetic storms.

In consequence of these disturbances, almost all our energies have to be devoted to the study and elimination of the disturbances, or to methods of discriminating between the source and the disturbances.

Enough has been said to show that a new chapter in science has to be written on "The Physics of the Sea," and that we have to go to school again and imagine ourselves living in a conducting or semi-conducting lamina which is almost opaque to the majority of disturbances, acting on electromagnetic waves as far does to ripples, so that they are absorbed in a few wave-lengths.

It is to be regretted that many of the most interesting and effective devices cannot be described for obvious reasons.

I. Detection.

In spite of the number of phenomena theoretically available, the practical range of detecting devices is narrowed down to a comparatively few phenomena and modes of application.

Fig. 1 shows three forms of hydrophone which have proved of considerable service. In the first, A, a heavy circular metal case is provided with a diaphragm on one side, to the centre of which is attached an ordinary button granular microphone. This is a fairly sensitive and effective hydrophone, and has been in continuous service. The determination of direction is as important as the actual detection, and fig. 1 (B) is one of the best forms of directional hydrophone. It consists of a thin metal diaphragm about 4 in. diameter supported in a heavy lenticular-shaped ring so that the water is on both sides of it. At the centre of this diaphragm a simple granular microphone is fixed in a watertight capsule. When the sound waves strike the diaphragm nearly normally the hydrophone has its maximum sensitiveness, but when they are edge on, they act equally and oppositely on the two sides of the diaphragm, so that the effect is neutralised and no sound is heard. The positions of minima are very sharp and well defined.

The variation of intensity is approximately represented by the polar curve, which shows a minimum when either edge is towards the source. On this account this portable directional hydrophone is called bi-directional. Its sensitiveness is only about one-fourth of that of the non-directional form, but it has proved of great value.

By fitting a "baffle" plate, supported a few inches away from one face of the diaphragm as in fig. 1 (C), the sound is virtually shielded from that face, and a single maximum can be observed when the other face is turned to the source. This gives a uni-directional hydrophone, but its directional properties are inferior to those of the unbaffled bi-directional instrument. The best results are obtained by coupling a uni-directional and a bi-directional hydrophone on the same vertical axis, and rotating them until silence is obtained on the latter combined with maximum intensity on the former instrument.

So far as fixed stations are concerned these hydrophones fulfil their promise very satisfactorily, but they are practically useless for the important case of listening from a moving ship, owing to the water noises produced by its motion.

An immense amount of work has been done on towed devices, in which microphones are enclosed in rigid or flexible stream-line bodies, which are towed behind the ship. Considerable success has been obtained with some of these devices, but a difficulty then arises as regards direction. In some cases a small directional hydrophone can be employed inside the towed body, but it is frequently preferred to tow two or more hydrophones and to obtain directional indications either by "binaural" or "sum and difference" listening.

The binaural method developed largely in the United States depends upon the simple principle that if sound falls upon two receivers separated by a short distance, it reaches them at different times unless the source is in the median plane between them. If the two receivers communicate with the two ears, the source will appear to be on one side or other; but by rotating the bar carrying the receivers, the source appears to cross over behind the observer from one ear to the other, and this cross-over occurs when the bar is perpendicular to the direction of the source. This method

has been found of the greatest value in the location of aeroplanes by employing two trumpets communicating by stethoscope tubes to the observer's ears, but it has been much less easy to apply to hydrophones, owing, first, to the difficulty of producing granular microphones which are identical in acoustic properties, and, secondly, to the fact that it is often impossible to rotate the coupled hydrophones when attached to a ship or enclosed in towed bodies. The difficulty is enhanced also by the fact that the velocity of propagation, and hence the wave-length of a given sound, are nearly five times as great in water as in air, so that the distance between the hydrophones must be correspondingly increased.

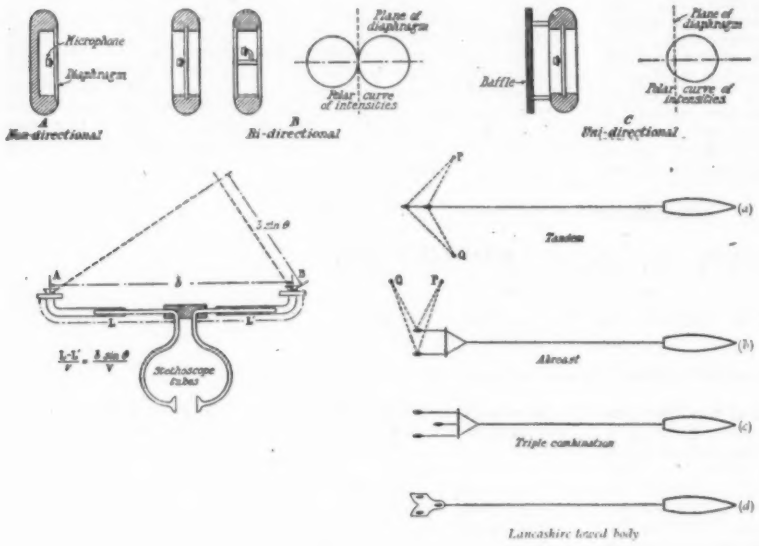


Fig. 1.—Types of Hydrophones.
Fig. 2.—Binaural Method with Rectilinear Compensator.
Fig. 3.—Towing Schemes for Hydrophones.

If two ordinary microphones are fixed close together so as to be similarly affected by a source of sound, and are joined to the primaries of two ordinary telephone induction coils, then if the secondaries of these coils are connected in series to a pair of receivers, the effect observed is either the sum or the difference of the effects of the two microphones according as the secondaries are assisting one another or are in opposition. But with ordinary carbon microphones it frequently happens that hardly any difference is noticeable, owing to different phase relations in the two microphones. By replacing the ordinary mica diaphragms by indiarubber the selective properties of the microphones are much reduced and better balance can be obtained. In this way, and by enclosing the microphones in rubber blocks, fairly perfect pairing can be obtained, which is essential if correct binaural listening is required.

The rotation of the bar carrying the microphone is a troublesome matter, and to obviate it, various forms of binaural compensator have been employed which enable directions to be obtained without rotation of the microphones. The compensators depend on the principle of introducing variable lengths of air path between the receivers and the observer's ears. If the sound reaches both microphones in the same phase, *i.e.*, from a point in the median plane between them, and each microphone is connected to a receiver at the corresponding ear of the observer there will be binaural balance; but if the source is on one or other side of this plane there will be a difference of time between the arrival of sound at the two microphones, which can be compensated by a different length of air path between the receivers and the ears. Fig. 2 shows diagrammatically a simple form of straight sliding compensator, in which the receivers are fixed at opposite ends of a long straight tube, the centre portion of which can slide in the end portions so as to obtain the required difference of path. A more convenient form of compensator is made by the Automatic Telephone Co., and is similar in principle to the original American instrument. Two circular plates are arranged to revolve smoothly over one another, and have grooves cut in their faces, forming the air paths. The sound from the receivers is introduced into these grooves and taken from them to the ear by rubber tubes, and by revolving one of the disks the length of air path on one side is lengthened, and on the other side shortened, so that by turning the compensator the same effect is produced as by rotating the microphones.

Instead of binauralling some observers prefer to work directly on the "sum and difference" principle. If the source is in the median plane between the microphones, and they are properly paired, there will be a certain amount of sound which can be balanced out either by swinging the microphone or by introducing the compensator as above. Prof. Spearman has introduced a reversing stopcock device for interchanging the stethoscope listening-tubes to the ears, which increases the accuracy of binaural listening.

Lastly, dealing with directional combinations, two or more simple hydrophones are towed simultaneously so as to have fixed base lines, and the binaural method with them. Two such hydrophones can be towed one behind the other as in fig. 3 (*a*), but in that case there will be no indication on which side the source is; the time difference is evidently the same for any point on a circle surrounding the axis, or for the points P and Q in the figure. By towing two hydrophones abreast with a spreader, as in (*b*), this ambiguity disappears, but it is then uncertain whether the source is ahead or astern. If three hydrophones are used as in (*c*) this ambiguity is eliminated, as binauralling can be conducted on any pair. In (*d*) we have the towed body devised by Messrs. Redfern & Dobie, in which three hydrophones are mounted on a board with streamed edges.

The above is only an outline of the immense amount of work which has been done on towed listening devices, to say nothing of the special cables which have been constructed to take the considerable strains involved. For this purpose cab-tyred cables with central steel cores have been largely used, and the various cable manufacturers have rendered great service in their design and construction.

Towed devices are troublesome to handle, and the modern tendency is in favour of apparatus for use on board ship. The principle of acoustic integration, apparently first put forward by Prof. A. W. Porter, points to the employment of large flat surfaces for reception. Many important applications of this principle have been made both in the United States and in this country, and considerable success has been obtained with the devices based on it. Its chief objection is that it is impracticable to swing a large receiver on board ship to receive from various directions; but this difficulty has been to a large extent overcome by introducing a variable phase difference into the receivers attached to different parts of the diaphragm, thus enabling a maximum sensitiveness to be obtained for various directions of the source.

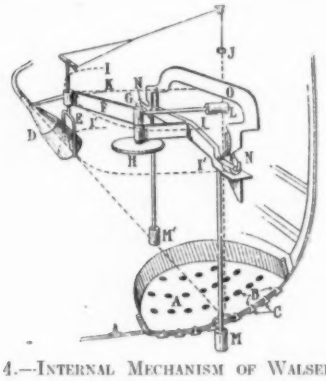


Fig. 4.—Internal Mechanism of Walser Gear.

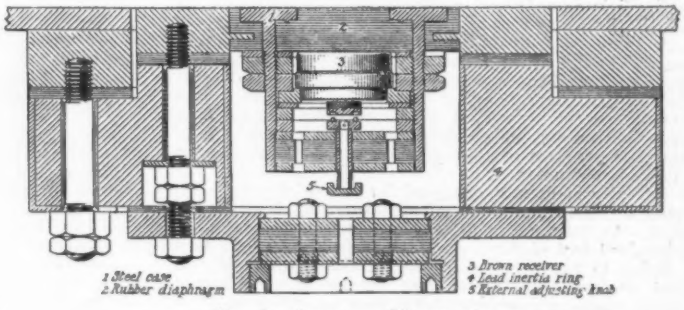


Fig. 5.—Air-drive Magnetophone.

The Walser gear, invented by Lieut. Walser, of the French Navy, instead of using a large plane receiving-surface, employs a pair of "blisters" on the two sides of the hull. Each of these blisters is about 3 ft. 6 in. diameter and is provided with a large number of thin circular diaphragms, so that the arrangement looks like the compound eye of an insect. When sound waves fall on this blister the vibrations of the diaphragms are communicated to the interior air and come to an approximate focus as in the case of a lens or rather of a "zone plate." A conical trumpet placed at this focus and provided with a rubber tube and ear piece is all that is required for listening. As the direction of the source changes, the position of the focus revolves round the centre of curvature of the blister, and by mounting the trumpets on suitable rotating gear, the observer is able to locate the source by first observing whether the sound is louder on the port or starboard side, and then rotating the trumpets till a maximum is obtained. Fig. 4 shows the internal mechanism of a Walser cabin; A is the blister; B, C diaphragms, D collecting trumpet, and E—N rotating gear.

A second device of great theoretical interest is the hydrogen or H tube of Mr. H. W. Hilliar. The velocity of sound in hydrogen and in water is very nearly equal. If, therefore, sound arrives at the end of a long tube at practically the same speed as it does in the water outside, and if the tube is turned towards the source, the sound entering at every part of it reaches a receiver or listening tube at the end of the same phase. This may be called the principle of longitudinal integration, as distinguished from that of transverse integration previously described, and it has the advantage that the whole of the sound collected from the entire surface of the tube is concentrated on a single receiver. If the source is not in line with the axis of the tube the axial velocities are not the same, and partial cancellation results, so that the device is directional. At ordinary temperatures, the velocity of sound in hydrogen is somewhat less than that in water, but by steam-heating the hydrogen the velocities can be made practically exactly equal, and the device has fairly definite directional properties.

Good work has been done in the application of inboard magnetophones with devices for eliminating water and other noises on the interference principle. Magnetophones are inferior to microphones in actual sensitiveness, but they have the advantage of having no grating noises, so that they will stand considerable amplification, and they are easy to pair for binauralling.

Fig. 5 shows Mr. B. S. Smith's "air drive" magnetophone, which consists simply of an ordinary Brown reed telephone receiver mounted behind a diaphragm fixed on a heavy metal ring which is attached to the ship's side with the intervention of a rubber sound-insulating ring. The vibrations of the diaphragm are communicated to the reed through the air in the interior, causing it to vibrate and to act as a magnetophone. By employing four or more of these devices at different parts of the hull, approximate directions can be determined, which can be rendered more exact by binauralling.

A very useful device in connection with listening arrangements of every kind, and which assists the reduction of disturbances with non-integrating hydrophones, is that introduced by Mr. J. A. Burgess. The sound from the receivers is led into an arrangement of tubes like a trombone so that it divides into two paths in parallel before re-uniting. If the difference of the two paths is half a wave-length for a particular frequency, that sound will be eliminated, and by employing a number of pairs of tubes a number of frequencies can be blotted out while other sounds can still be heard. In this way the disturbances due to water noises, &c., may be greatly reduced, and the frequencies of different sounds determined. An improved form of this arrangement has been devised by Mr. B. S. Smith on the lines of the American compensator, the required differences of path being obtained by a number of rotating disks.

All the devices so far described depend upon the sound emitted by the submarine. When the latter is stationary or drifting they are useless, and acoustic methods can only be employed if the submarine either reflects or intercepts sound from another source. Reflection or echo methods are the more convenient, as the source of sound can be on the observing ship, and as the object to be detected is small compared with any useful range the source must be of considerable intensity. A large number of devices have been constructed for producing powerful sounds under water. In the Wrightson syren a stream of water of about 30 gallons per minute is employed with a motor rotating a cup perforated with holes, as in the ordinary syren. The Fessenden oscillator consists of a diaphragm which can be attached to the side of a ship, and to which is fixed either a soft-iron armature attracted by an electromagnet excited by an A.C., or a coil traversed by an A.C. and moving in the gap of a powerful electromagnet. By means of these powerful acoustic transmitters, not only is sound signalling possible at long distances, but echoes have been obtained at considerable range. For open deep-sea work they may be of considerable value, where the object to be detected is far away from reflecting surfaces, but in shallow confined areas they may lead to great confusion, and it is, therefore, desirable to concentrate the emitted disturbance into a narrow beam and to rotate it in any direction required. This can be done by the principle of integration, and most interesting and powerful methods of location have been developed on these lines, which enable the direction and approximate range of a submerged object to be determined from a ship at full speed. High-frequency acoustic detection is probably the most powerful method of detection yet devised, and arose out of the *Titanic* disaster in 1912, when Mr. Lewis Richardson took out two patents for detecting obstacles by echo either in air or water, by employing a beam of "sound" of frequency from 5,000 to 100,000 periods per second. These echo methods promise to be of the greatest value for the detection of rocks and other ships, and probably of icebergs, and also for sounding operations.

The foregoing account gives an outline only of the work which has been done on acoustic detection. The modern improvements in submarine machinery and tactics, however, have very greatly reduced the possibility of detection by acoustic means.

Electromagnetic methods are usually based on the Hughes induction balance, which was seized on as the most attractive principle for detection. Unfortunately this impression is illusory. The method is essentially heterodynamic, so that we have to deal with the attenuation of the magnetic field from the coils and again with that of the induced field from the object to be detected. The magnetic field from a coil of small dimensions compared with the range, diminishes as the cube of the distance, and the absorption due to the conductivity of the water is very large at all but the lowest frequencies. As the reaction due to the obstacle also diminishes as the cube of the distance and is similarly affected by absorption, its reactive effect on the coils diminishes as the sixth power of the distance, and the absorption is squared, so that although the sensitiveness may be remarkably great when the object is close to the coils, it practically vanishes at a very moderate range. From the point of view of measurement, a moderately high frequency is desirable, in order that the inductive effects should be large in comparison with the resistance of the coils; but absorption absolutely precludes this. In consequence the practical possibilities of this method seem theoretically to be very small, and all experience has confirmed this.

Certain optical methods have been employed with some success, but do not warrant description. Thermal devices do not seem promising. Much valuable work has been done as regards secret signalling, which may be a valuable aid to detection, but this cannot be gone into.

II. Defence and Destruction.

Defence and destructive methods are of no less importance than detection, but the bulk of the applications to submarine mining, &c., must, however, be kept secret.

A most valuable device which has become fairly well known and which has probably done more for the protection of vessels against mines than all other inventions put together is the paravane, invented by Commander C. D. Burney, R.N. This consists of a torpedo-shaped body towed from the vessel to be protected, and is provided with vanes so that it keeps outwards and below the ship. When the towing cable meets the mooring rope of a mine it forces it away from the ship, and the rope slips into jaws which cut it through. Explosive paravanes have also been made for protection against submarines.

The determination of the pressures developed in the water by explosive charges of different magnitudes has been investigated by two independent methods.

In the first, ably employed by Mr. H. W. Hilliar, the pressure is measured by the compression of small copper gauges similar to those used in ordnance trials.

The second method gives a continuous record of the variation of pressure. It was suggested by Prof. Sir J. J. Thomson and developed by Mr. D. A. Keys, and depends on the piezo-electric phenomenon so fully studied by the late Prof. Curie. If a crystal such as quartz or tourmaline is subjected to pressure along its optic axis it becomes electrically charged on its surfaces, and as the elasticity of such crystals is very high this charge is developed practically instantaneously, and is proportional to the total force on the crystal independently

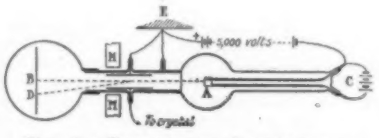


Fig. 6.—Cathode-ray Oscillograph.

of its dimensions. By mounting plates of quartz or tourmaline in contact with a rigid metal backing, and facing them with an insulated tinfoil sheet, the charge developed can be communicated to an electrometer so that the arrangement makes a very convenient pressure indicator. For the purpose of recording very rapidly-varying pressures a cathode-ray oscillograph is used. The form hitherto employed was lent by the Cavendish Laboratory, and is shown in fig. 6.* A stream of electrons is emitted by an 8-volt tungsten filament

* Fig. 6 was taken from a paper by Prof. J. C. McLennan, F.R.S., see *Elec. Rev.*, August 22nd, 1919.

in a bulb, and passes through a pinhole aperture in a copper anode, between which and the filament a constant potential difference of about 4,000 volts is maintained by a high-voltage generator. The fine cathode-ray pencil thus produced passes first between the poles of a laminated electromagnet, and then between two long brass plates which are respectively connected to the tinfoil coating of the crystal receiver and to earth. After passing these plates the cathode-ray pencil passes into a camera in which a fluorescent screen is fixed. The whole apparatus is exhausted to an X-ray vacuum by means of a Gaede and auxiliary pumps. When the filament is glowing and the high potential difference is applied, a bright spot is seen on the fluorescent screen. On exciting the electromagnet this spot moves transversely across the screen in a direction perpendicular to the magnetic field, and on applying a small potential difference between the two brass plates, it moves in a direction at right angles to this. For the purpose of obtaining the records the electromagnet is excited by an A.C. of about 80 cycles per second, causing the spot to move over the screen in a simple harmonic manner, each traverse taking 1/160th second. The crystal receiver is suspended in the water with its face turned towards the explosive charge, and is connected through a highly insulated low-capacity cable to the brass electrode plate of the oscillograph. When the explosion occurs the beam is deviated laterally by an amount proportional to the pressure at each instant and a time-pressure curve is traced out on the screen. This can be recorded by lowering a photographic plate in front of the screen, by means of a cord and pulley turned through an airtight gland.

A new form of cathode-ray oscillograph has been designed at Shandon which is portable and self-contained, and in which a roll-film camera is employed, actuated from outside by electromagnetic mechanism. A number of special instruments have also been devised for studying and recording the motions of mines in tideways, &c.

(To be continued.)

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Prepayment Attachment for Watt-hour Meter.

For supplying energy to small consumers and a shifting population, such as, for example, are found at summer resorts, the prepayment attachment for a watt-hour meter (fig. 1) just placed on the market by the Westinghouse Electric & Manufacturing Co., is said to be especially useful. By means of the attachment a standard single-phase watt-hour meter can be converted into a prepayment meter, and if desired it can be changed back to a standard meter by replacing the standard register and cover. The prepayment attachment mechanism

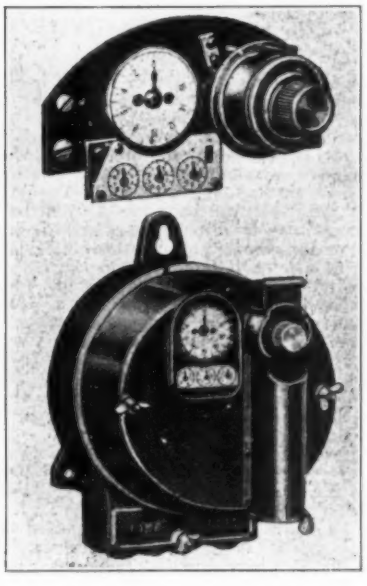


Fig. 1.—Prepayment Attachment for Watt-hour Meter.

is entirely mechanical. By placing a coin in the top of the coin chamber and turning the knob in the direction of the arrow the meter is made ready to give electrical service as required by the consumer. This operation of the knob winds a clock spring which is unwound by gears at a speed depending upon the rate per kilowatt-hour for which the energy is supplied. When the spring is completely unwound, a quick-break switch is automatically opened and the customer is without energy until another coin has been placed in the coin mechanism.—*Electrical News* (Toronto).

The Tungar Rectifier.

In our issue of May 25th, 1917, we described the Tungar rectifier, which consists of a bulb (which performs the rectification), a transformer, a reactance, and an enclosing case with the necessary connecting leads. The bulb operates in the same way as the thermionic valve used in wireless telegraphy and telephony, permitting current to flow in one direction only. In addition to the low-voltage tungsten filament (the cathode), there is a graphite electrode (the anode), a discharge of electrons taking place between the two. The bulb is filled with argon, and the combination of the heated filament and the gas provides the valve action, since the current can only flow from the anode to the cathode. The transformer and reactance are used for adjusting the current and voltage to the values required.

Tungar rectifiers are very simple in operation, and are suitable for charging accumulators and for the direct operation of various low-voltage D.C. appliances. The home garage outfit (fig. 2) consists of a Tungar bulb, an auto-transformer, a 6-amp. D.C. plug-fuse, bayonet adapter to fit standard lampholder, and a flexible cord for connecting to the battery. The case is of black japanned sheet metal, with a perforated cover. There are two sizes, 2 and 5 to 3 amperes, D.C.—the secondary voltage in each case being from 7.5 to 15 volts. The bulb of the 2-ampere Tungar will carry 2.5 amperes continuously.

The small rectifier is suitable for charging batteries for bells,

Fig. 2.—B.T.H. Tungar Rectifier; 5 to 3 amperes, 7.5-15 volts, D.C.

buzzers, telephones, and fire alarms. The larger Tungar (5 to 3 amperes) is suitable for all charging service in a private garage. The normal A.C. voltages on which these rectifiers are intended to operate are 110 or 220 volts, 25 to 60 cycles. Larger outfits are made, up to 12 amperes, 75 volts, D.C., for use in public garages and battery service stations.

Further particulars may be obtained from The British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C. 4.

A New High-pressure D.C. Generator.

We have received some particulars of a new type of machine, suitable for use as generator, motor, or transformer of direct current, at high or low pressure, from Messrs. Machines Electriques a Courant Continu Haute Tension Romain Boin, of Avenue Blonden, 66, Liége, Belgium. The machine has a fixed armature and rotating field-magnet, with rotating brushes, so that the armature windings are not subjected to centrifugal force, and can, therefore, be better insulated and more conveniently arranged than in the usual form. The field-magnet winding is of course easily held in place; it is fed by a low-pressure winding in the armature, the current being led in by slip-rings and brushes, and in view of its construction can be driven at a higher peripheral speed than an armature, with safety. The rotating brushes are balanced so that centrifugal force does not affect their pressure on the commutator, and are connected with slip-rings. The most notable novelty appears to be the arrangement of the commutator segments, which are in echelon, as shown in fig. 3, each ring of segments having a separate set of brushes; by this means the distance between consecutive segments is greatly increased, so that the voltage per section can be correspondingly increased

without fear of flashing over. Sparking is also said to be absent.

Thanks to the facilities for insulating the armature windings, and to the design of the commutator, very high pressures can be attained in the working winding, and this is put forward as the main advantage of the design. A machine of one kilowatt output at 2,000 volts has been built, which weighs only 28 kg. (62 lb.); the makers claim that a reduction of weight of 50 per cent., as well as an equal saving of labour, can be effected by this design, which also offers facilities for

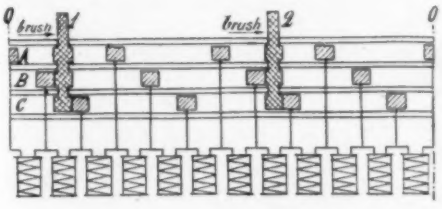


Fig. 3.—Arrangement of Commutator Segments.

repair, and allows the many known advantages of high-pressure direct current to be realised. On the other hand, in addition to the high-pressure commutator, rotating brushes, and slip-rings, the machine requires a low-pressure commutator and rotating brushes, with two slip-rings to allow of regulation. As a power of one kilowatt at 2,000 volts D.C. means only 0.5 ampere current, the behaviour of the small machine affords no criterion of that of a large one. Generators of the ordinary type giving 100 amperes at 5,000 volts have been running in London for many years.

REVIEWS.

Whittaker's Electrical Engineer's Pocket Book, 4th edition. Edited by R. E. Neale. Pp. xii+671; 346 figs. London: Sir I. Pitman & Sons. Price 10s. 6d. net.

The general arrangement followed is similar to that of the earlier edition, but the work has been entirely rewritten and brought up to date.

The title is somewhat misleading. It is certainly possible to carry the book in a fairly capacious pocket; it contains a number of useful tables and an excellent index, but there the resemblance to an ordinary pocket-book ceases.

Except for the condensed style, the general treatment is much nearer that of the text-book. The aim throughout has been to produce a book which, whilst being concise enough for reference by practising engineers, is still sufficiently detailed to be read by students with profit.

The difficult task of reconciling these opposing requirements has been carried out with much success.

Each separate section has been specially written by an expert in the particular subject, and in view of the specialisation which has taken place in every branch of the industry, this appears to be the only practicable method, but it has one disadvantage in that it leads to a certain amount of overlapping.

The editor claims that the field covered is broadly that of industrial electrical engineering, but, in view of the fact that there is no reference to telegraphy, telephony, or wireless engineering, this claim can hardly be substantiated.

Although it may not appeal so much to the imagination, there is as much real engineering work done by those who deal in microwatts as by the more numerous class who are concerned with the heavier branches of electrical engineering.

Among the mathematical tables, some very useful little sketches are given, which show graphically the trigonometrical functions of angles by the aid of circle diagrams, and will prove helpful in solving those little problems which are so apt to remind us of the time that has elapsed since the days of our mathematical classes.

As the work was in the press at the time that the new I.E.E. wiring tables were published, both the old and the new figures have been included, the latter being printed in heavy type to distinguish them.

The chapter on electromagnetic machinery contains an extraordinary amount of information in a small space, ranging from the production of an electromotive force to the latest development of the multiphase commutator motor.

There is a great deal of valuable information on power stations and power distribution, and a considerable section is devoted to switchgear of all types.

Notes are included on the use of electricity in agriculture and the electrical precipitation of smoke and fumes, which has become of practical importance within the last few years.

A very valuable feature is the number of references throughout the work to literature in which fuller information can be obtained on the subjects treated, in fact, the pocket-book can be relied on either to supply the information required or indicate where it can be obtained.

There are a great many illustrations which, in spite of their small scale, are mostly very clear, and the work as a whole can be confidently recommended as a valuable addition to the library of the electrical engineer.

The How and Why of Radio Apparatus. By H. W. Secor. Pp. 160, illustrated. New York: Experimenter Publishing Co. Price $1.75.

The writer of this little volume points out an important fact to his readers and also to other authors. A volume on wireless telegraphy cannot be complete. A student must read all books on wireless telegraphy which he can possibly obtain in order that his knowledge shall be complete. If he wants to know all about vacuum tubes, he should procure a book specialising in that subject. If he is interested in the design of transformers, let him consult a book devoted to this branch of electrical science. Unfortunately, the author's advice cannot be followed, in this country at least. And yet there seems no adequate reason for this absence of specialising in wireless literature. The tendency at present is to write book after book on "wireless telegraphy," "wireless telegraphy," and again "wireless telegraphy." The works of Eccles and Fleming are classics. They are invaluable and indispensable as works of reference. In many respects they have no equal in any country of the world. But having works like this, there seems no need for the deluge of books on wireless communication. Certainly Stanley's "Wireless Telegraphy" figures pre-eminently as a descriptive technical work, but there are many others which contribute nothing to wireless literature. Let us have *specialised* works now that the general subject has been ably covered. Why should not books be written on such subjects as the following: The Poulsen arc system, radio-navigation, submarine signalling, wireless receiving systems, valve transmission, valve telephony, wireless amplifiers and relays, the elimination of atmospherics, aircraft wireless communication?

Each one of these subjects is now sufficiently developed to form the basis of a separate small volume. If written by authorities on these particular branches, the books would be noteworthy additions to wireless literature.

The author of the volume under consideration evidently shares these views. Although he presents the subject of wireless telegraphy as a whole, his treatment is novel, and he urges the student to consult other works for detailed information. He truly says: "No one book covers everything, and if it did, you would not want it." His aim is to give the experimentalist a fundamental knowledge of principles—not principles cold and unattractive, but amply illustrated by practical applications. The book is readable—essentially readable. The author is an experimentalist himself—an enthusiast. One sees it in every line, and it is that which gives the volume a certain appeal which somehow rarely is found in this country. In America the amateur is catered for as he is in no other country. The literature at his disposal stimulates his interest. It is easy to sneer at some of the extraordinary Yankee-isms which appear in their journals; to hold up one's hands in pedantic horror at the homely explanations. Nevertheless, they "get there." The American amateur does more than turn the switches of a ready-made wireless set.

It is little wonder then that experimentalists in this country are looking to American publications for information and stimulation. Few brilliant wireless authors have written books which really appeal to the amateur. A book for amateurs should be written by an amateur; one who has not forgotten the difficulties that he himself encountered, and one who does not scorn to stoop to the level of his readers in order to raise them to his own level. The author of the "How and Why of Radio Apparatus" is such a one. That is why his little volume deserves the success that is assured for it.

Chapter I opens up with a description of the induction coil and transformer as used for wireless transmission. A kick-back preventer is described in connection with the use of A.C. mains. Two condensers in series are connected across the primary, and connection is taken to earth from a point between the condensers.

Chapter II deals with the transformer, which is very frequently used by the experimentalists of the United States. Various types of transformers are described. A practical example of the design of the low-frequency circuits is given. The principle of working out examples is one which will appeal to experimental wireless men.

The next chapter is entitled "Radio Transmitting Condensers." Means of calculating the capacity of condensers are given, and the various units are correlated. Formulæ are given for the A.C. current passed by a condenser, the capacity required for various powers and A.C. frequencies, and the size of condenser required when a rotary spark gap is employed. The chapter concludes with a table of dielectric strengths.

The following chapter on spark gaps gives an account of synchronous and asynchronous rotary gaps. Quenched and rotary-quenched gaps (the latter an unusual type) are also discussed.

Various types of inductances and oscillation transformers are described in Chapter V, which is followed by a discussion of various kinds of detector circuits. The circuits are representative, and the reader is expected to look elsewhere for the thousand and one circuits which may be arranged with valves.

Chapter VII is an account of various types of condensers, and includes several novel types. In fact, throughout the book the author has infused new ideas and devices not usually described in cut-and-dried text-books.

Detectors are discussed in Chapter VIII. Crystal, magnetic, electrolytic, Fleming valve, and three-electrode tube detectors receive attention. In Chapter IX, telephone receivers are described in their various forms. The watch-case, Brown, monotelephone, condenser, thermal, dynamometer, Baldwin, adjustable pole-piece, Leath, Berger, and Ader telephone receivers are described. One cannot help wondering if such a list would be presented by many other authors. The Fessenden heterodyne telephone is described, but the way it acts without rectification is not explained, although many are ignorant of its *modus operandi*.

The important subject of wireless amplifiers is next presented to the reader. Here again we have numerous types which will be new to the British reader. The multi-phone, Brown, Telefunken tuned-reed, detectiphone, acoustic, and compressed-air amplifiers are described. Various relays are also discussed, including a selenium cell arrangement. Naturally, the valve amplifier receives attention. Only an unpractical type is shown. The high resistances across transformer windings could be omitted, and single filament and plate batteries used. The Lieben-Reisz relay which is described is too prehistoric for a book of this nature. The chapter ends with a description of the Alexanderson magnetic amplifier.

The measurement of wave-length and decrement occupies the space of the next chapter. Radio antenna construction is next described, and a valuable set of curves is given showing the natural wave-length of different antennæ.

Chapter XIII will be found a very valuable one to the experimentalist. Formulæ relating to the calculation of inductance are given with worked-out examples. The practical measurement of inductance also receives adequate attention in the following chapter.

The question of loose-couplers is next considered from a designing point of view.

The book concludes with an appendix of tables and formulæ. Taking the book as a whole it is deserving of high praise, and is worthy of imitation in this country.

Although the treatment does not pass beyond the stage suitable for students, the book will be found of interest to all, and of paramount interest to those who desire a sound elementary and general knowledge of radio-telegraphy.—John Scott-Taggart.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C.1.

24,956. "Earthing neutral point of three-phase systems." A. M. Taylor. August 30th.

24,975. "Electric switches and boxes therefor." H. F. McLoughlin and Simplex Conduits, Ltd. August 30th.

24,988. "Telephonic instruments." Dictograph Products Corporation and E. W. Pattison (Dictograph Products Corporation.). August 30th.

25,011. "Electromagnetic action for pipe organs." M. B. Langdon and V. A. H. Weber. August 30th.

25,013. "Means for rheostatic control of two arc lamps for kinematographic projection, &c." A. J. Cook. August 30th.

25,017. "Automatic switches for electric irons." W. H. Dingle and J. M. Urquhart. August 30th.

25,022. "Apparatus for measuring ratio of strengths of two currents." Soc. Da et Dutilh. August 30th. (France, September 30th, 1919.)

25,026. "Magneto-electric ignition apparatus." Bosch Akt. Ges. R. August 30th. (Germany, August 30th, 1919.)

25,029. "Electric water-heater." R. J. Frost. August 30th.

25,031. "Means for transmitting messages." J. C. Grant. August 30th.

25,033. "Telegraphic receiving and transmitting apparatus." J. A. L. Horn and E. C. R. Marks (Horn). August 30th.

25,035. "Storage batteries." D. W. Davis. August 30th.

25,046. "Receiving apparatus for electrical oscillations." Ges. für Drahtlose Telegraphie. August 30th. (Germany, September 6th, 1919.)

25,055. "Electric motors." F. L. Smith. August 30th.

25,065. "Radio receiving systems." Radio Communication Co. and J. Scott-Taggart. August 31st.

25,066. "Modulation systems, &c., in radio communication, &c." Radio Communication Co. and J. Scott-Taggart. August 31st.

25,083. "Miners' electric safety, &c., lamps." F. Law and C. Milton. August 31st.

25,103. "Electric standards, &c." G. Green. August 31st.

25,115. "Electrical apparatus for imparting reciprocating movements to hammers, chisels, &c." Metropolitan-Vickers Electrical Co. August 31st. (France, September 19th, 1919.)

25,124. "Submarine signalling apparatus." T. F. Wall. August 31st.

25,125. "Means for limiting rise of speed in alternating-current generators." T. F. Wall. August 31st.

25,172. "System of winding multi-layer electrical coils for use as inductances for wireless telegraphy, telephony, &c." W. W. Burnham. September 1st.

25,174. "Device for controlling electrical signs, signalling, gunfiring, exposures, &c., by clockwork." E. J. Ray. September 1st.

25,177. "Overhead collectors for electric tramways and railways." W. B. Blackburn. September 1st.

25,187. "Electric film re-winders." P. Berry. September 1st.

25,215. "Electric-lighting systems for motor-vehicles." C. Tidd. September 1st.

25,241. "Current-regulators for incandescent lamps, &c." Cutler-Hammer Manufacturing Co. and Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). September 1st.

25,243. "Electric lamps for kinematograph apparatus." G. A. Knapton and New Union Electric Co. September 1st.

25,248. "Electric contact devices." C. C. Farmer. September 1st. (U.S., December 10th, 1919.)

25,249. "Car brake and power-controlling devices." C. C. Farmer. September 1st. (U.S., March 26th.)

25,258. "Electrical rivet-heating machine." J. Moll. September 1st.

25,264. "Stopping or slowing electric motors." A. S. Medway, E. M. Medway and E. C. Smith. September 1st.

25,271. "Motor-cycle engine-starters." Soc. Anon. des Etablissements Ballot. September 1st. (France, September 2nd, 1919.)

25,286. "Incandescent electric lamps." L. A. Lepiney. September 1st.

25,289. "Electric cables." E. W. Clarke. September 1st.

25,301. "Dynamos." T. G. P. Healey and H. H. Smith. September 2nd.

25,349. "Sparking plugs." W. Marsh. September 2nd.

25,356. "Sparking-plug connections." R. McGreevy. September 2nd.

25,357. "Automatically-reclosing circuit breakers." E. C. Raney. September 2nd.

25,370. "Production of electrical oscillations by thermionic valves." Radio Communication Co. and J. Scott-Taggart. September 2nd.

25,378. "Production of electrical oscillations by thermionic valves." N. Lea and Radio Communication Co. September 2nd.

25,379. "Telephone receivers." A. O. French-Brewster. September 2nd.

25,387. "Converting alternating into direct current and vice versa." W. A. Price. September 2nd.

25,388. "Electric arc projection apparatus." Etablissements Continsouza Soc. Anon. September 2nd. (France, November 19th, 1919.)

25,390. "Valve transmitters and receivers for wireless telegraphy and telephony." H. Morris-Airey, A. K. Macrorie, and G. Shearing. September 2nd.

25,408. "Radio-signalling systems." Radio Communication Co. and J. Scott-Taggart. September 3rd.

25,411. "Electric clocks, &c." S. W. Pilling. September 3rd.

25,413. "Improving transmission on alternating-current electric systems." A. M. Taylor. September 3rd.

25,426. "Valves for wireless signalling systems." G. G. Farley. September 3rd.

25,438. "Repeaters for multiplex signalling systems." Western Electric Co. September 3rd. (U.S., September 26th, 1919.)

25,441. "Electric photographic printing-machine." H. P. Doubell. September 3rd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

5,130. "Mercurial collector for electrical machines." E. Bolton. June 7th, 1919. (149,372.)

6,067. "X-ray apparatus." M. B. Rodriguez. March 11th, 1919. (149,376.)

6,206. "Starting apparatus for engines and more particularly for aircraft engines." Bijur Motor Appliance Co. March 25th, 1919. (124,723.)

11,661. "Systems of radio communication." British Thomson-Houston Co. (General Electric Co.). May 9th, 1919. (149,409.)

11,666. "Electric switches." H. K. Ansingh and Metropolitan-Vickers Electrical Co. May 9th, 1919. (149,410.)

11,682. "Electric motors and particularly electric traction motors." W. E. Ireland. May 9th, 1919. (149,411.)

11,873. "Thermionic devices." J. A. Fleming. May 12th, 1919. (149,422.)

11,953. "Process of and apparatus for assembling electric switches and accessories." J. H. Tucker & Co. and J. B. Tucker. May 13th, 1919. (149,427.)

12,005. "Thermionic receiving devices for wireless telegraphy and telephony." H. J. Round. May 13th, 1919. (149,433.)

12,006. "Apparatus for wireless telegraphy and telephony." H. J. Round. May 13th, 1919. (149,434.)

12,008. "Receiving systems for wireless telegraphy and telephony." H. J. Round. May 13th, 1919. (149,435.)

12,862. "Mechanical coupling for electric conductors." W. Thomas and L. W. Roderick. May 22nd, 1919. (149,459.)

13,036. "Signalling systems with special reference to telephonic circuits." E. A. Graham, W. J. Rickets and E. A. Sanftleben. May 23rd, 1919. (149,461.)

13,479. "Use of electron discharge devices in signalling systems." British Thomson-Houston Co. (General Electric Co.). May 28th, 1919. (149,466.)

13,521. "Electromagnets or relays." Relay Automatic Telephone Co., G. H. Bryant and T. M. Inman. May 28th, 1919. (149,467.)

13,673. "Devices for attachment of electric conductors to insulators." F. H. Krebbs. May 29th, 1919. (149,472.)

14,315. "Electric heating apparatus." M. J. Railing and C. G. Nobbs. June 5th, 1919. (149,482.)

14,428. "Dynamo-electric generators for use in lighting cycles or like vehicles." W. A. Hymas. June 6th, 1919. (149,485.)

17,639. "Electric cut-outs." Siemens Bros. & Co. and E. A. Petithory. July 14th, 1919. (149,506.)

18,439. "Electric condenser plate construction." Dubilier Condenser Co. April 11th, 1919. (141,658.)

21,841. "Electromagnetic wave signalling systems." J. Hollingworth. September 5th, 1919. (149,532.)

26,326. "Means for electrolysing water." A. P. de Corradi. October 27th, 1919. (149,556.)

29,027. "Devices for starting internal-combustion engines." S. L. Price. November 21st, 1919. (149,562.)

29,273. "Spark plugs." C. H. Haight. November 24th, 1919. (149,563.)

29,515. "Electric stoves." Soc. Anon. Calor. November 29th, 1918. (135,859.)

29,722. "Reflectors for electric-light fittings." H. G. Sproates. November 28th, 1919. (149,564.)

30,797. "Controlling devices for electrically-wound clock-work and other mechanism." Fabriker Elecktr, Apparate F. Sauter. December 24th, 1918. (137,038.)

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710. "Electric furnace doors." Booth Electric Furnace Co. April 4th, 1918. (137,540.)

1,507. "Housings for mechanical interrupters of electric ignition apparatus." American Bosch Magneto Corporation. February 7th, 1919. (138,602.)

2,724. "Electric switches." Igranic Electric Co. (Cutler-Hammer Manufacturing Co.). January 28th, 1920. (149,584.)

5,310. "Dynamo-electric machines." E. J. Harman and E. Le Bas. July 2nd, 1919. (Divided application on 141,116.) (149,587.)

7,386. "Storage battery locomotives." Mancha Storage Battery Locomotive Co. August 31st, 1918. (Divided application on 132,234.) (140,105.)

14,775. "Manufacture of incandescent electric lamps." British Thomson-Houston Co. (General Electric Co.). May 9th, 1917. (Divided application on 147,955.) (149,605.)

19,792. "Jig for assembling electric switch parts." J. B. Tucker and J. H. Tucker & Co. May 13th, 1919. (Divided application on 149,427.) (149,607.)

19,793. "Jig for assembling electric switch parts." J. B. Tucker and J. H. Tucker & Co. May 13th, 1919. (Divided application on 149,427.) (149,608.)

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